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DEPARTMENT OF MINES
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Iron Ore Occurrences in Canada

IN TWO VOLUMES in 1 vol.

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Introductory
BY
A. H. A. Robinson, B.A.Sc.

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INTRODUCTORY.

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ERRATA.

On page 3 — in place of table caption "Iron Ore Utilized in Canada during the Years 1887–1916," *read*, Iron Ore Produced, and Utilized in Canada, 1887–1916.

„ „ 8 — in place of box heading in last column of table, *read*, Ontario ore used in Ontario blast furnaces, *not* "Ore used in Ontario blast furnaces."

„ „ 20 — line 23 from top, *read*, After producing, *not* "After reducing."

„ „ 20 — „ 15 „ bottom, „ Leckie vein, *not* "Leckie mine."

„ „ 21 — „ 3 „ top, „ known, *not* " shown."

„ „ 38 — in legend for Plate IX, *read*, tubes, *not* "tube."

„ „ 68 — line 24 from top, *read*, Ennis & Co., *not* "Ennison Co."

„ „ 69 — „ 3 „ „ „ Iron ore: all imported to Ontario from U. S., *not* "Iron ore: all imported comes from U. S."

„ „ 69 — line 10 from bottom, *strike out* "Aberdeen township."

„ „ 69 — „ 9 „ „ „ „ " „ Additional."

„ „ 69 — „ 7 „ „ „ „ "Deroche tp."

IRON ORE OCCURRENCES IN CANADA.

INTRODUCTORY.

References to Canadian iron ore deposits are of frequent occurrence in mining and scientific literature, and many excellent descriptions of individual deposits and districts have been published from time to time. With the exception of two or three short papers, however, no attempt has been made to bring together all this scattered and fragmentary information, and put it in a form at once compact and readily accessible for reference to those interested.

Some years ago, the preparation of a report with this end in view was undertaken by Mr. Einar Lindeman, acting under instructions from the Director of the Mines Branch, in connexion with a general investigation then being carried on into Canada's iron ore resources. Before this work was completed, however, a Committee, of which Mr. Lindeman was a member, was appointed by the Government to make a special report on the condition of the iron mining industry in Canada; and collected, as a part of its work, considerable information—much of it hitherto unpublished—concerning Canadian iron deposits. The combined information: that collected by the Committee itself, and that previously prepared by Mr. Lindeman for a Mines Branch report, was then compiled by Mr. L. L. Bolton, and incorporated as a part of the Report of the Committee on the Iron Industry. This part of the Committee's report contains a very complete summary of the available information respecting iron ore occurrences in Canada, hence was placed at the disposal of the Director of the Mines Branch for publication.

With the exception of such minor changes as were necessary to prepare it for publication, no alterations have been made in Mr. Bolton's work. References to various magnetic survey maps prepared by officers of the Mines Branch since 1903 have been added.

The report is divided into two parts: Vol. I contains descriptions of the principal iron mines in Canada, to which there has been added, in a supplement, a description of the Wabana mines in Newfoundland: of interest in this connexion, since they are controlled, operated, and their ores largely used by Canadian corporations. Vol. II contains descriptions of Canadian iron ore occurrences in general.

The arrangement throughout is geographical, the grouping being by Provinces and their subdivisions, proceeding in order from west to east. The individual occurrences are, as a rule, described separately, and each description is followed by a list of the authorities on which it is based.

The great importance of obtaining as full a knowledge as possible of our iron ore resources was early recognized, and, in 1903, the systematic investigation of Canada's iron ore deposits was first set on foot by the present Director of the Mines Branch, Dr. Eugene Haanel, at that time Superintendent of Mines for Canada. From that time up to the present this work has been carried on continuously under his direction, and bulletins and maps covering different iron mines and iron mining districts have been issued to the public as the work progressed.

The Mines Branch, in its investigations, has given particular attention to the magnetometric surveying and mapping of deposits of magnetite. This has been done for several reasons: (1), because it was desired to introduce a method for the investigation of magnetic ore deposits that had been found particularly useful in a country like Sweden, but which was practically unknown in Canada; (2), because by this method definite information concerning the extent and shape, and hence, in some degree, the value of our numerous known deposits of magnetite could be more readily obtained than in any other way; (3), because the maps made in the course of these surveys would be of considerable service as guides in the exploration and development of such of the deposits as seemed worthy of further attention; and (4), because work of this kind would have no tendency to overlap but would be entirely supplementary to that of other investigators. As a result of this magnetometric work much definite knowledge concerning our magnetite deposits has been secured, and erroneous impressions regarding the continuity and extent of some of them corrected.

Copies of the magnetometric and topographical maps made in the course of this work, a list of which will be found in the table of contents, accompany this report.

GENERAL STATEMENT.

Discovery of iron ore in Canada is recorded as early as 1667; and in 1733 there was already one forge in operation. This earliest plant was succeeded in 1737 by a group of forges at Three Rivers, Quebec, which remained in active operation almost continuously until 1882, being at that time the oldest active iron producers in America. A number of other small plants were erected at various points in Canada during the latter part of the eighteenth, and the earlier part of the nineteenth centuries; but the iron industry did not assume any large proportions, or commence to take on its modern form until 1896. Since then its growth has been rapid.

In the earlier days, when the iron industry was small, sufficient ore was available locally to meet all the demands of the furnaces. Since 1896, however, this condition of affairs has changed; both the production of iron ore and its consumption in blast furnaces have increased; but the latter so much more rapidly than the former that in 1916 the total production of iron ore in Canada was only equal to 15·5 per cent of the total ore smelted in Canadian blast furnaces.

The part played by native ores in Canada's iron industry is indicated in the following table. The last column, showing the ratio of total production to consumption in blast furnaces, has been added as giving, perhaps, a fairer view of the situation than the column preceding; since that portion of the total production not used in Canadian furnaces will offset an equal amount of imported ore so used.

Iron Ore Utilized in Canada during the Years 1887-1916.

Calendar Year.	Production of iron ore in Canada. Short tons.	Iron ore charged to Canadian blast furnaces. Canadian. Short tons.	Imported. Short tons.	Total. Short tons.	Canadian ore in total ore charged. Per cent.	Ratio Canadian production to total ore charged. Per cent.
1887....	76,330	60,434	....	....	....	....
1888....	78,587	54,956	....	....	....	....
1889....	84,181	65,670	....	....	....	....
1890....	76,511	57,304	....	....	....	....
1891....	68,979	60,933	....	....	....	....
1892....	103,248	96,948	....	....	....	....
1893....	125,602	124,053	....	....	....	....
1894....	109,991	108,871	....	....	....	....
1895....	102,797	93,208	....	....	....	....
1896....	91,906	96,560	46,300	142,860	67·6	64·3
1897....	50,705	53,658	55,722	109,380	49·0	46·3
1898....	58,343	57,881	77,107	134,988	42·9	43·2
1899....	74,617	66,384	120,650	187,034	35·5	39·9
1900....	122,000	71,341	112,042	183,383	38·9	66·5
1901....	313,646	156,613	361,010	517,623	30·2	60·6
1902....	404,003	125,664	559,381	685,045	18·3	58·9
1903....	264,294	82,035	485,911	567,946	14·4	46·5
1904....	219,046	180,932	454,671	635,603	28·4	34·4
1905....	291,097	116,974	861,847	978,821	12·0	29·7
1906....	248,831	221,733	982,740	1,204,473	18·4	20·7
1907....	312,856	244,104	1,117,260	1,361,364	17·9	22·9
1908....	238,082	209,266	1,051,445	1,260,711	16·6	18·8
1909....	268,043	231,994	1,235,000	1,466,994	15·8	18·3
1910....	259,418	149,505	1,377,035	1,526,540	9·8	17·0
1911....	210,344	67,434	1,628,368	1,695,802	4·0	12·4
1912....	215,883	71,588	2,019,165	2,090,753	3·4	10·3
1913....	307,634	139,436	2,110,828	2,250,264	6·2	13·7
1914....	244,854	182,964	1,324,326	1,507,290	12·1	16·2
1915....	398,112	293,305	1,463,488	1,756,793	16·7	22.6
1916....	339,600	221,773	1,964,598	2,186,371	10·1	15·5

N.B.—This table is compiled from the figures given in the annual reports of the Division of Mineral Resources and Statistics, of the Mines Branch, Ottawa.

Practically all the imported ore comes either from Wabana, Newfoundland, or from the Lake Superior iron ranges in the United States. It might be noted in passing, however, that the word "imported" has not the same significance as applied in the two cases. The Wabana ore, on which the Nova Scotian iron and steel industry is based, comes from a sister British colony, and is owned and mined by Canadian companies for use in their own furnaces; on the other hand, the Lake Superior ores are owned and mined by United States interests, and are bought on the open market by the Ontario smelters.

At present, all the Canadian ore produced is the output of two mines, the Magpie and the Helen. Both are situated in the Michipicoten district, in Ontario, and both are owned and operated by the Algoma Steel Corporation of Sault Ste. Marie, Ontario.

In any consideration of Canada's iron ore resources, a point that should not be lost sight of, is that the total area comprised in the Dominion is very large, and that much of it is practically unexplored so far as its iron ore possibilities are concerned. By reference to the general map at the end of the volume, it will be seen that, with very few exceptions, all the known occurrences are situated in the older and more or less settled and known districts. In the comparatively unexplored regions of the north, large areas of iron bearing rocks occur at a number of points, but, on account of their inaccessible location, there is, at the present time, little to induce a thorough exploration of them in a search for ore bodies.

SUMMARY.

A summary review of the iron ore situation in the different provinces follows.

BRITISH COLUMBIA.

Up to the present the production of iron ore in British Columbia has been an almost negligible quantity. The total recorded from 1886 to 1903, both years inclusive, was only 62,578 tons; since 1903 the only production recorded was in 1907 when 2,500 tons were shipped.

Most of the ore—practically all magnetite—was sent to Irondale, Washington, U.S.A., where it was used in the production of pig-iron in a small charcoal blast furnace. The balance went to lead smelters to be used as flux.

The small production of British Columbia has been due, not so much to the lack of iron ore deposits, as to the lack of a market for the ore. In the absence of a local iron smelting industry, there has been no particular incentive either to develop the known ore-bodies, or to search for new ones.

The different varieties of iron ore found in British Columbia, include magnetites, hematites, limonite or bog ores, and clay ironstones.

Magnetite.—The most important of the known ore bodies are a series of magnetite deposits which occur on the islands along the coast in the western part of the Province. Among the better known localities in which these are found may be mentioned: Gordon river, Head bay, Klaanch river, and Quinsam river, in Vancouver island; Louise and Moresby islands, in the Queen Charlotte group; Texada island; and Redonda island. Promising deposits are also reported as occurring on other islands, and at various points on the coast, but little definite information is available regarding them. In general character, all these deposits agree closely. The iron content is variable, ranging from 45 to 65 per cent. Phosphorus is often below the Bessemer limit; on the other hand, sulphur is usually so high that the ore would require preliminary roasting, to render it suitable for economic smelting. Most of the deposits carry copper in the form of chalcopyrite, and in portions of some of them at least, the quantity may be sufficient to constitute an ore of copper rather than of iron. Garnet, amphibole, and other silicates are abundant, and locally, in such quantities, that hand sorting of the ore is necessary.

Practically, all the ore bodies are located at or near the contact of limestone with igneous rocks, and genetically they are regarded as replacement deposits of the contact metamorphic type. As such, they are characteristically uncertain, and irregular in outline, and the association of ore and wall rock so variable that it is not safe to assume their extension beyond the zone of direct observation. Mining operations have not been extensive enough to determine their vertical shape and extent, or their mineralogical composition at depth.

Making due allowance, however, for lack of development, and for all doubtful and uncertain factors, it is still possible to say that there is in the aggregate, in the known magnetite deposits of the coast district of British Columbia, a sufficiently large tonnage of ore available to support a small local iron industry for many years when conditions justify its establishment. There is little doubt, also, that active exploration would disclose many bodies of iron ore at present unknown.

The coast magnetites, while somewhat handicapped by their composition, and while they will in most, if not in all cases require to be roasted before smelting, are capable of producing a good merchantable pig-iron. They can be easily and cheaply mined, and are located close to tide water. Besides an adequate supply of suitable ore, other important considerations in the establishment of an iron industry are the proximity of fuel and flux, the ease with which the raw materials can be assembled at the point of production, and a market for the product at profitable prices. On the British Columbia coast, ore, coke, and limestone suitable for flux, are all obtainable within easy reach of each other, and all are located so close to navigable water, open the year round, that transportation would be of the cheapest. These considerations suggest that the ores will ultimately be smelted locally; on the other hand, the labour situation in British Columbia is not the most favourable.

Failure to establish an iron smelter in the past has usually been ascribed to the lack of sufficient market for pig-iron; it is possible that the real limitation to the smelting of these ores locally will be found to be the cheapness with which Chinese and Indian pig-iron can be laid down on the coast market.

The only inland deposit of magnetite in British Columbia that has had much development work done on it is the Glen mine, on the south side of Kamloops lake. Previous to 1901, some 12,000 tons of magnetite were mined and shipped from this property to be used as a flux by lead smelters. Judging by the available records of analyses, the ore is of excellent quality, and while development is not sufficient to prove the reserve tonnage claimed (8,000,000 tons) there is apparently a considerable quantity available.

Hematite deposits have been found in a number of localities in British Columbia, notably, Bull river, Kitchener, and Chilcotin; but, while analyses indicate some ores of good quality, there is, as yet, no evidence that they are representative of bodies of sufficient size to be of commercial importance.

Limonite and *bog ores* are found at Quatsino sound on Vancouver island, on the headwaters of Summit creek in the Omenica mining division, on Lamb creek, and at various points in the Lillooet mining division. The more promising of these are the deposits at Summit creek, and at Quatsino sound.

At Summit creek the ore, a comparatively pure limonite, is of good grade, and should be especially valuable for mixing with the dense coast magnetites in the blast furnace. The full extent of the deposit is not known, but it is evidently large. At present it is too far from transportation to be available; the distance to Copper City on the Grand Trunk Pacific railway being about 38 miles.

The limonite and bog ore deposits found at Quatsino sound, while they have large areal extent, vary greatly in thickness, and appear, on the average, to be shallow. In 1907 an attempt was made to mine the ore on one of the most promising properties, and about 1500 tons were shipped. The average thickness of ore over the area worked was found, however, to be only about 24 inches, and the yield too small to be profitable.

Clay ironstone occurs to a limited extent, associated with the coal deposits of Vancouver island, but has not yet been reported in such quantity as to make it a probable source of iron. It is also found associated with the coal deposits in the Queen Charlotte islands, but in the undeveloped condition of these properties, it is impossible to form any idea of the quantity that might ultimately become available.

ALBERTA, SASKATCHEWAN, AND MANITOBA.

Up to the present time, no iron ore deposits of such size and quality as to make them of commercial value have been found in the Middle West provinces. There are, however, very large areas unprospected in all three, in which iron ores may be discovered in the future.

Several writers have drawn attention to the fact, that a steel plant located in western Alberta would have essentially the same location with reference to coal-fields and transportation routes as the Colorado Fuel and

Iron Company's plant at Pueblo, Colorado. The favourable situation with respect to the coal-fields and the growing industrial market of the prairie provinces should, therefore, make the discovery of even a moderately good iron ore deposit in this district, or in the adjoining portions of eastern British Columbia, a matter of more than ordinary importance.

At Burmis, near Blairmore in Alberta, beds of what appear to be consolidated black magnetic sands, are found. They carry in the neighbourhood of 40 per cent iron, and 5·5 per cent titanic acid, hence are not suitable for iron ore in their natural condition. Tests might show, however, the possibility of producing a commercial product from them by magnetic concentration.

At Black bay, on the north shore of Athabaska lake, in Saskatchewan, considerable areas of iron-bearing quartzites and conglomerates are reported to occur. So far as known the deposits are too low grade to be valuable, but the region has never been thoroughly explored, and were it not for its inaccessibility, would offer a promising field for the prospector of iron ore.

Hematite occurs on Black island in Lake Winnipeg, but a little prospecting work done on the deposit a few years ago gave only discouraging results.

Clay ironstones are found in numerous places throughout the three provinces, but nowhere in sufficient quantity to be of any value.

ONTARIO.

Ontario has to its credit the largest total production of iron ore of any of the Canadian provinces. Production by years and the total production to date are given in the following table, compiled from the figures given in the Annual Reports of the Ontario Bureau of Mines. For the period from 1869 to 1895 complete records are lacking; the amount set down being an estimate based on the best information available.

Previous to 1889, all the ore mined in the Province, with the exception of such small quantities as were used in the earlier attempts at iron smelting, was exported to the United States. From 1889 to 1895, both years inclusive, production ceased entirely. About 1896, a system of bounties inaugurated by the Federal and Provincial Governments to encourage the manufacture of iron and steel from native ores, had the desired effect of stimulating the industry, and the following years witnessed the erection of blast furnaces at various points in the Province: at Hamilton in 1895; at Deseronto in 1898; at Midland in 1899; at Sault Ste. Marie in 1904; and at Port Arthur in 1907. Strenuous efforts were made to use Ontario ores as far as possible and thus obtain the advantage of the liberal bounties offered; iron mining took on a new lease of life, and prospecting for iron ores became general.

In eastern Ontario old mines were re-opened, and for a time ore was shipped in small quantities. Unfortunately the quality of most of it was poor, and cobbing had to be resorted to, to rid it of sulphur and other deleterious ingredients, and bring it up to merchantable grade. As a result these mines have again, one by one, lapsed into idleness.

Iron Ore Produced and Utilized in Ontario, 1869–1916.

Calendar Year.	Iron ore produced in Ontario.	Iron Ore used in Ontario Blast Furnaces.			ONT. Ore used in Ontario blast furnaces. Per cent.
		Ontario ore.	Imported ore.	Total.	
	Tons.	Tons.	Tons.	Tons.	
1869 to 1895	567,276	.....	.....	.....	.....
1896	15,270	15,270	35,868	51,138	29·8
1897	2,770	2,770	34,722	37,492	7·4
1898	27,409	20,968	56,055	77,023	27·2
1899	16,911	24,494	85,542	110,036	22·2
1900	90,302	22,887	77,805	100,692	22·7
1901	273,538	109,109	85,401	194,510	56·1
1902	359,288	92,883	94,079	186,962	49·6
1903	208,154	48,092	103,137	151,229	31·8
1904	53,253	50,423	173,182	223,605	22·6
1905	211,597	61,960	383,459	445,419	13·9
1906	128,049	101,569	396,463	498,032	20·4
1907	205,295	120,156	388,727	508,883	23·6
1908	216,177	170,215	342,747	512,962	33·2
1909	263,777	220,307	543,544	763,851	28·8
1910	230,656	143,284	678,890	822,174	17·4
1911	175,631	67,631	848,814	916,445	7·3
1912	117,357	71,589	1,062,071	1,133,660	6·3
1913	195,937	132,708	1,095,561	1,228,269	10·8
1914	275,956	163,779	752,560	916,339	17·8
1915	394,054	293,305	623,094	916,399	32·0
1916	320,487	215,366	1,056,810	1,272,176	17·0
Total	4,349,144.				

In northwestern Ontario, the discovery, in 1899, of the deposit of brown hematite that later developed into the Helen mine, together with the fact that throughout this part of the Province there are widespread outcrops of banded jaspers, magnetites, and hematites, of the same geological formations as the Vermilion and Mesabi iron ranges in Minnesota, led to feverish activity in the search for iron ore. Very large sums of money were spent in looking for new deposits and in the exploration of the known ones. The net results of these efforts have been disappointing; we have, it is true, the Josephine mine (still undeveloped); Atikokan, with its high sulphur ores; the Magpie, Helen and other siderite bodies; and a variety of the lower grade, siliceous deposits of banded iron formation. But the only large body, both high grade and of good quality, yet discovered in Ontario, is that at the Helen mine.

Since 1899, owing principally to the output of the Helen, the iron ore production has averaged in the neighbourhood of 220,000 tons per annum, and reached a maximum in 1915, when 394,054 tons were produced. This, however, is a long way short of the amount of ore used annually in the production of pig-iron, and the proportion of native ore, as compared with foreign ore, used in Ontario blast furnaces, is disappointingly small. The only furnace run entirely on Ontario ore, since the revival of iron smelting in 1896, was the Atikokan Iron Company's furnace at Port Arthur, which during its period of operation, from 1907 to 1911, used roasted Atikokan magnetite alone.

The imported ores used in Ontario all come from the United States, Lake Superior district.

With the rapidly approaching exhaustion of the hematite ore at the Helen mine, the maintenance of the present rate of iron ore production will depend on the possibility of profitably utilizing the known bodies of inferior ores, or the discovery of new bodies of high grade ores. The most promising of the more accessible portions of the Province have been pretty well gone over by the iron ore prospector, and the discovery of any large new ore bodies in them is more likely to be made by the underground exploration and diamond drilling of known occurrences, rather than by ordinary surface prospecting. There is, however, still a large part of the more inaccessible portions that is virtually unprospected, and promising areas, like the Animikie rocks at Sutton Mill lakes in the district of Patricia, may yet be found to contain valuable deposits of iron.

All the usual varieties of ore are to be found in Ontario; including hematite (brown, red, and specular), magnetite, siderite, and bog ore. In the past, by far the most productive class has been hematite—followed by magnetite. At the present time the bulk of the output is roasted siderite; the figures for 1916 being 210,522 short tons of roasted siderite (this includes some high sulphur ore from the Helen mine sent to be roasted with the Magpie ore), and 109,965 short tons of hematite.

Brown Ore.—Of the total production of hematite in Ontario, by far the greater part has been of the brown variety, from one mine in the Michipicoten district—the Helen. The output of this mine from its opening in 1900 to the end of 1916, has been 2,645,110 short tons: the largest output yet recorded from any iron mine in Canada. The ore, which consists of a mixture of hematite, with hydrous oxides of iron, largely göthite, is classed as a non-Bessemer, brown ore. Associated with it are large bodies of siderite and pyrite, from which it has probably been derived by oxidation. The oxidized ore is now nearly all worked out, and it is evident that the future of the mine will depend on whether profitable use can be made of the accompanying bodies of iron carbonate. Exploration of these, to obtain a fuller knowledge of their extent and quality, was carried on by the owners in 1913, 1914, and 1916, Ore, similar in character to that at the Helen, occurs at a number of other points in the Michipicoten district; but the only other place where it has been found in workable quantity is at the Josephine mine. Here, some 850,000 tons of ore, a large part of which is said to be of Bessemer grade, averaging 59 per cent in iron, are said by the owners to have been proved up by diamond drilling. The deposit, however, has not yet been developed to the producing stage, though preparations for doing so were under way until interrupted by the outbreak of the European war.

Limonite, or brown ore, is also found in the Timiskaming district, on the Mattagami and Opasatika rivers, where it has been formed, apparently, by the oxidation of iron carbonate occurring in the Devonian limestones of the region. The ore is very variable in its composition, and on the whole, low grade. Little is known of the extent of the deposits, which are some distance from transportation.

Hematite.—In the vicinity of Loon lake, about 25 miles east of Port Arthur, red hematite is found in the Animikie rocks of the district. The deposits occur in certain beds in the formation, and appear to have considerable areal extent, but interlayered siliceous material renders them too low grade to be merchantable as mined. From the property of the Dominion Bessemer Ore Company there was shipped, in 1909, a small quantity of hand-sorted ore in two grades, No. 1 running 52 per cent iron, and No. 2, 40 per cent. Since 1909, all operations have ceased.

Red, and specular hematites of good grades are found in small quantities in the vicinity of Sault Ste. Marie; notably in the townships of Deroche, Aberdeen, and Aberdeen Additional. Between 1874 and 1878, small quantities of specular ore were shipped from the Stobie mine in Aberdeen township. From the Williams and Breitung mines in Deroche township, a few small shipments of specular ore of good grade were made to the Sault Ste. Marie smelter in 1905. All the deposits appear, however, to be of very limited extent, and no ore bodies large enough to be of commercial importance have so far been exposed.

Other localities in northwestern Ontario where hematite has been found are: Hunter's island, Steeprock lake, Bending lake, Lac Seul, Sutton Mill lakes, the Mattawin iron range, Gunflint lake, Dog lake, Black Sturgeon lake, Round lake, east of Lake Nipigon, Batchewana river and Groundhog river. The hematite in all these occurrences is found intimately associated with silica, and usually, magnetite in the banded iron formation; in none is the iron sufficiently concentrated to constitute commercial ore.

On a number of them, such as those at Hunter's island, Steeprock lake, Bending lake, Gunflint lake, and on a part of the Mattawin iron range near Shabaqua, a certain amount of diamond drilling has been done in unsuccessful attempts to locate ore bodies.

On the Central and Southern iron ranges east of Lake Nipigon, also, a large amount of exploratory work, including some diamond drilling, has been done. On the Central range, banded siliceous hematite carrying in places between 40 and 50 per cent in iron has been found, and on the Southern range considerable areas of banded silica, hematite and magnetite carrying from 30 to 40 per cent, but no bodies of merchantable grade.

On the Algoma Eastern Railway claims at Groundhog river, considerable areas of banded magnetite, hematite and jasper running about 35 per cent in iron, have been explored by trenching.

A number of experimental tests have been made with this siliceous hematite-magnetite mixture of the iron formation in attempts to devise a commercial process for its concentration. None of them have been successful, however, and considering the physical characteristics of the material, the outlook for a successful solution of the problem is not bright.

In southeastern Ontario, from a number of properties, chief among which are the Wallbridge, Dalhousie, and McNab, hematite has been produced in the past to the total extent of probably 150,000 tons. The ores are said to have been of good quality, but little information about the individual mines is available.

The deposits were all small; some of them the upper oxidized portions of pyrites beds. There has been no production from any of them for some years, nor is there likely to be much in the future.

Magnetite.—Magnetite is of more frequent occurrence in the Province than any of the other classes of ore, and next to hematite, has been economically the most important. The total production of magnetite in the Province, to the end of 1916, would probably be in the neighbourhood of 1,175,000 tons.

Important occurrences found in western Ontario are those in the Atikokan "iron range," a belt of green schists with interbedded lenses of magnetite and pyrrhotite that outcrops at intervals for a distance of about 16 miles along the Atikokan river. On that part of the range west of Sabawe lake, most of the deposits contain so much sulphur in the form of pyrrhotite and pyrite that their value as iron ores is very doubtful. On the eastern end of the range, about a mile east of Sabawe lake, large bodies of magnetite have been opened up at Atikokan mine, the property of the Atikokan Iron Company of Port Arthur. Between 1907 and 1911 some 90,608 tons of magnetite averaging 60 per cent iron, 0·11 per cent phosphorus, and 2·01 per cent sulphur, were shipped to the blast furnace in Port Arthur, and after roasting to remove the sulphur, smelted for the production of foundry pig-iron. Development work at the mine was carried on until 1913, but no ore has been shipped since 1911 when the Company's blast furnace closed down.

The total amount of ore proved by exploration and development on the Atikokan range is fairly large. The amount of intermixed rock found in many parts of the deposits, however, is sufficient to adversely affect the amount that could be mined economically. Much of the ore, also, is so high in sulphur as to make its profitable utilization by present metallurgical methods doubtful. It is difficult, therefore, to make any definite estimate of the amount of ore *commercially* available.

With the exception of the Atikokan range, nearly all the magnetite occurrences known in northern and western Ontario are outcrops of banded iron formation. Speaking generally, this consists of chert, jasper or other closely related siliceous material interbanded with magnetite and hematite, and, to a smaller extent, with iron carbonates and pyrite. In some cases it may be a lean siliceous magnetite, showing banding only obscurely, and carrying up to between 40 and 50 per cent of iron—though as a rule the iron content is considerably less than this. Or it may consist of narrow bands of magnetite, or hematite, or a mixture of both, alternating in distinct layers with chert and jasper. The total length of the known beds in the Province must reach into the hundreds of miles. It is seldom that the iron content will average up to 35 per cent over any considerable area.

The occurrences on Hunter's island and in the Gunflint-Whitefish lakes area, like those at Loon lake and Sutton Mill lakes, are found in Animikie rocks. The rest are all believed to occur in rocks of Keewatin age.

The similarity to iron-bearing formations found on the Minnesota iron ranges has caused great expectations to be entertained of the possibilities of that found in Ontario, and it is this commercially non-available lean iron formation, rather than ore, that has provided the basis for the reports, sometimes seen in print, of hundreds of millions of tons of ore of the United States Lake Superior type still lying undeveloped in Ontario. Even under the most favourable conditions only a small fraction of the iron in these formations is likely to be in ore of commercial grade. In Ontario, much money has been spent in exploring them, but so far, only at the Helen and Josephine mines in the Michipicoten district, have secondary concentrations of the iron to high grade ore bodies of commercial size been found associated with them.

Among the more extensive and better explored of the iron formation areas are: Hunter's island; Bending lake; the Mattawin iron range; the Gunflint-Whitefish lakes area; Loon lake area; Lake Savant; the Onaman iron ranges; the Nipigon iron ranges; the Michipicoten iron ranges; Goulais river; Woman river; Groundhog river; Burwash lake; Shining Tree lake area; Wanapitei lake area; Lake Timagami; and the Moose Mountain district.

At the Moose Mountain mine, much time and money has been spent in an unsuccessful attempt to produce a high grade commercial product from the lean siliceous magnetite of the iron formation. The ore as found at this mine is of two types: the first is a more or less massive magnetite, free from banding, and possibly represents a portion of the original iron formation that was subsequently enriched by iron-bearing solutions; the second is a fine-grained banded siliceous magnetite, somewhat higher in iron than the typical Keewatin iron formation, since it carries about 37 per cent iron and 45 per cent silica. From the ore of the first type it was found possible to produce a marketable concentrate, carrying about 55 per cent in iron, by magnetic cobbing, and a considerable quantity was produced in this way. Since, however, the quantity of crude ore of this type available was very limited, it became evident that, if the mine was to continue in operation, means must be found for utilizing the lower grade banded material of the second type. Experimental tests showed that by very fine grinding, followed by magnetic concentration on Gröndal separators, a good separation of magnetite from gangue could be effected, and that by subsequently briquetting and sintering the resultant concentrate, a product of Bessemer grade, carrying 65·6 per cent of iron, and excellently adapted for blast furnace use could be obtained—2·1 tons of crude ore being required to produce a ton of concentrates.

A mill to treat the low grade ore along these lines was accordingly built in 1912. From the start, however, practical difficulties were met with in its operation, and in 1915, after three years experimenting and the production of some 10,159 gross tons of finished briquettes, it was finally closed, the process having proved unsuccessful commercially.

In southeastern Ontario magnetite has been mined in the past from a number of deposits scattered through the counties of Haliburton, Peterborough, Hastings, Renfrew, Frontenac, Lanark, and Leeds. The total production from these, as nearly as can be estimated from the information now available, has been between 700,000 and 750,000 tons. The chief producers were, in the order of their production, Blairton, Wilbur, Bessemer, Coe Hill, Glendower, Black Bay, Radnor, and the Matthews and Chaffey (titaniferous) mines. All of them are now idle. None of the individual deposits are very large. The deepest any of them has been worked is about 350 feet; in most the workings are much shallower. The known dimensions of the deposits do not indicate that there is in the aggregate more than a very few millions of tons of commercial grade available.

The ores vary from lean magnetite gneiss with bands and ribs of magnetite to deposits of nearly pure magnetite. The better grades will average 50 to 55 per cent in iron, but considerable cobbing would have to be done to keep any large quantity up to this standard. The sulphur content, while variable, is usually too high to allow the ore to be used in the blast furnace without some preliminary treatment for its removal.

Tests made on ores from a number of the mines have shown that many of them are well adapted for magnetic concentration. By crushing, concentrating on magnetic separators, and sintering the concentrates on a Dwight-Lloyd machine, a high grade, porous product, low in sulphur, and excellently adapted to blast furnace use, can be obtained. While it may be that none of the individual mines have ore reserves large enough to warrant the erection of a plant of sufficient capacity to ensure the economical working of such a process, it should be possible to make such a project feasible, by combining the output of a number of properties, and erecting a concentrating plant for its treatment at a point centrally located with respect to the mines.

Titaniferous magnetites are found at Seine Bay; Haystack mountain; Nemegos; Mountain lake; near Gooderham, in Haliburton county; at the Orton mine in Hastings county; and at the Matthews and Chaffey mines. Previous to 1871, some 20,500 tons of this material were shipped from the Matthews and Chaffey mines to United States blast furnaces. As titaniferous magnetites are not now in favour with blast furnace men they have no market as iron ores at present.

At many points along the shores of the Great Lakes, such as Peninsula harbour on Lake Superior, concentrations of magnetite sands are found. Some accumulations of this kind on the north shore of Lake Erie were smelted in a small furnace at Normandale about 100 years ago. They are not, however, of economic importance.

Siderite.—Since 1913, roasted siderite from the Magpie mine has appeared in the list of ores produced in Ontario, and this material now constitutes the bulk of the output of the Province.

Shipments of roasted siderite from the Magpie mine have been made, as follows:—

1913	22,327	short tons.
1914	109,838	„
1915	132,906	„
1916[1]	210,522	„

The raw ore is a dense, fine-grained siderite, partly altered to magnetite. It carries about 35 per cent of iron, and an objectionable amount of sulphur in the form of pyrites. This is roasted in rotary kilns to a product running about 51 per cent in iron, and 0·25 per cent sulphur. The roasted siderite ranks as an Old Range Bessemer ore and is practically self fluxing.

The Magpie ore-body is about 50 feet wide. In 1915 a working shaft had been sunk on it to a depth of 337 feet, and it had been developed for a length of about 1,500 feet. West of the shaft the ore-body is cut by a trap dike about 100 feet wide. Unlike the deposits of oxidized ore in this region,

[1]Partly high sulphur hematite from the Helen mine roasted with the Magpie ore.

the Magpie deposit shows no trace of the typical banded iron formation. Its walls are the sericite and chlorite schists of the Keewatin, and its appearance points to its origin as a vein.

Development work has proved up large reserves of ore of the same grade as that now being used, together with some of inferior quality.

Besides the large bodies of siderite known to exist at the Magpie and Helen mines, it occurs also in the following localities in the Michipicoten district—at some of them in considerable quantity: the Morrison prospect (near Goudreau station); on the Johnston locations; at Brooks lake; at the Ruth mine; at the Josephine mine; and on the Bartlett property. Any process, therefore, that will make it possible to use profitably ore of this class is of more than usual importance. The results obtained at the Magpie mine are of special interest in this connexion.

Siderite is also found on the Mattagami and Opasatika rivers, in the Timiskaming district, where it occurs associated with limonite in the Devonian limestone of the region. Some of it is of exceptionally high grade, but the extent of the deposits is unknown, and they are at present a long way from transportation.

Large deposits of lower grade are also reported to occur at Steeprock lake, in the Rainy River district, and in the Animikie rocks, in the vicinity of Port Arthur.

Bog Ore.—Deposits of bog ore are known to occur at a number of points in both the older and newer sections of the Province. As far back as 1813, small quantities were smelted at Normandale, in Norfolk county. More recently, a small quantity from Oxford county was smelted in the Hamilton furnace. In northwestern Ontario it is found in a number of places, as in the vicinity of Niblock station, on the Canadian Pacific railway. So far as known, however, none of the deposits are large enough to be of economic interest.

QUEBEC.

Iron ore was first mined and smelted in the Province of Quebec early in the eighteenth century, and from that time until 1883, the industry was carried on almost continuously at Three Rivers in the St. Maurice district. Other furnaces using local ore were operated at Radnor Forges and at Drummondville, the last to shut down being the Drummondville furnace in 1911. The ores used were bog ores, with charcoal for fuel. The output of all the furnaces was small, and the industry derived its chief importance from the superior quality of the pig-iron made.

Furnaces have also been built at various times and places in attempts to smelt some of the other classes of ore found in the Province, but all were short lived, and none of them achieved commercial success.

The output of iron ore, never very large, has latterly occupied a very subordinate place in the mineral production of Quebec; by years it is as follows:—

	Short tons.		Short tons.
1886		1901	15,489
1887	13,404	1902	18,524
1888	10,710	1903	12,035
1889	14,533	1904	16,152
1890	22,305	1905	12,681
1891	14,380	1906	9,933
1892	22,690	1907	12,748
1893	22,076	1908	10,103
1894	19,492	1909	4,150
1895	17,783	1910	4,503
1896	17,630	1911	3,616
1897	22,436	1912	1,185
1898	17,873	1913	5,102
1899	19,420	1914	nil
1900	19,000	1915	nil
		1916	nil

Types of ore found include: magnetite (titaniferous and non-titaniferous), ilmenites, bog ore, and hematite.

Magnetite.—Non-titaniferous magnetites are found in the counties of Argenteuil, Compton, Megantic, Ottawa, and Pontiac. None of the deposits are of any very great extent. The only ones known to be large enough to be of any interest are those at the Bristol mine in Pontiac county, and the Forsyth mine in Ottawa county.

The ore in both these mines is predominantly magnetite, with a little accompanying hematite. That at the Bristol mine is so high in sulphur that it would require roasting. The best grade of ore, in both, carries between 50 and 60 per cent in iron, but the quantity of this grade available appears to be small, and to work either property on a commercial scale it would likely be necessary to mine poorer material and concentrate it to merchantable grade.

Titaniferous magnetites are found in the counties of Beauce, Saguenay St. Maurice, and Terrebonne, and in the Lake St. John district. They occur as basic segregations in anorthosite and gabbro masses and are, for the most part, individually quite small. The largest of those known are the Cran de Fer falls deposit, in Saguenay county, and that at the St. Charles mine, in the Lake St. John area. At Cran de Fer falls the ore contains 50 per cent or over in iron, and 12 to 15 per cent titanium, and there are believed to be at least 300,000 or 400,000 tons available. At the St. Charles mine, it is estimated that there are at least 1,000,000, and possibly 5,000,000 tons in the deposit, which shows in the outcrops 50 per cent iron, and 10 per cent titanium. On account of their titanium content, magnetites of this type would not, at present, be marketable as iron ores. Some activity has recently been manifested in investigating their possibilities, however, and it is possible that in the near future they may become of commercial importance.

Closely related to the titaniferous magnetites, and occurring like them as basic segregations in anorthosite, are the *ilmenites* found in Charlevoix and Terrebonne counties. These deposits carry from 40 to 45 per cent iron, and 21 to 25 per cent titanium. They are not at all, or only feebly, magnetic. They have been mined to some extent, and the ore shipped to be used in the electric furnace for the production of titanium alloys.

Hematite.—Small pockets and narrow veins of excellent hematite were mined at the Haycock mine in Ottawa county in 1873. The deposits were very small, and the enterprise was soon abandoned.

Small occurrences are reported at various other points in the Province, but are all too small and unpromising to be of interest.

Bog Ores.—Bog ores are of widespread occurrence, but are now chiefly of historic interest. Beds on the north shore of the St. Lawrence in the vicinity of Three Rivers, were worked for over 150 years, and were the source of supply for the small charcoal furnaces formerly operated in that locality. On the south side of the St. Lawrence, the Drummondville furnace was run on bog ores obtained in that neighbourhood. Some of the deposits are worked out, and those that remain, while numerous, are not thought to be extensive enough to furnish much ore.

Magnetic Sands.—At a number of places along the north shore of the Gulf of St. Lawrence, accumulations of black sand (magnetite and ilmenite) are found, and attention has been attracted to them as a possible source of iron. Within recent years their extent and suitability for this purpose have been investigated by different parties. So far there has been no attempt to follow up these preliminary investigations by commercial operations.

From the point of view of possible source of future iron ore supplies, the District of Ungava, which includes the northern portion of the Province of Quebec, deserves special attention. In this District, large areas of sedimentary rocks including low grade bedded deposits of magnetite, hematite, and jasper are known to occur—the formation showing a striking resemblance to the Animikie rocks of the Lake Superior iron ranges. Situated as they are, in a wilderness far from transportation, and difficult of access, they remain as yet unprospected, though their promising character is such as to justify the hope that deposits of iron of economic value may be found in them.

NEW BRUNSWICK.

New Brunswick, like all the other provinces in Eastern Canada, except Prince Edward Island, had, in early days, its small local iron industry based on local ores.

Between 1848 and 1884, about 70,000 tons of hematite, obtained from deposits in the neighbourhood, were smelted in a small furnace near Woodstock, in Carleton county. The deposits were very shallow and the iron content of the ore low.

Some limonite from small deposits at Maugerville, a few miles southeast of Fredericton, was also smelted in the same furnace.

As a producer of iron ores, however, the Province has never been prolific. From 1886 to 1909, no output is recorded; from 1910 to 1916, shipments to the extent of 202,850 tons were made, all from one mine.

The only known deposits that have any economic interest are those found near Austin Brook, in Gloucester county, about 23 miles southwest of the town of Bathurst, and known as the Bathurst mines. They consist of fine-grained, siliceous magnetite with which is intermixed some hematite. Interbanded with the magnetite and hematite there are more or less chlorite and hornblende schists, and quartz. The iron content varies in different layers from 35 to 59 per cent, the average being from 43 to 47 per cent in different parts of the ore bodies; phosphorus runs about 0·8 per cent.

Genetically, the deposits are thought to be a partial replacement of schistose quartz porphyry; the iron-bearing solutions having possibly been derived from igneous intrusives found in the vicinity of the ore-bodies.

The ore as mined having been found too low in iron for profitable shipment, a concentrator was erected in 1911, to bring it up to merchantable grade by a process of crushing, screening, and jigging. The plant was started in July, 1912, and since that time shipments have been of concentrates, running 48 to 49 per cent in iron. In 1913, all operations ceased.

The concentrating process adopted did not prove satisfactory; the average improvement in iron content being only about 2 per cent. It is thought, however, that ore of merchantable grade can be produced by a system of selective mining without concentration.

An estimate of the ore reserves, based on the evidence afforded by magnetometric surveys and diamond drill holes, is placed at 18,600,000 tons to a depth of 500 feet.

On the Ellis iron claim, about 9 miles north of the town of Bathurst, a deposit of interbanded magnetite and garnet, from 4 to 14 feet wide, has been traced for a distance of about 900 feet. Average samples taken across the deposit show 45 to 48 per cent of iron.

NOVA SCOTIA.

Nova Scotia, though the seat of large iron and steel industries at the two Sydneys and New Glasgow, is not at the present time a producer of iron ore. Nevertheless, deposits of iron ore of various kinds are numerous and widely distributed through the Province; with the exception of the Pre-Cambrian gold-bearing series occupying the southern part of the mainland all of the larger divisions of sedimentary and accompanying igneous rocks in Nova Scotia show iron ore minerals in such quantities as to have attracted at least a passing attention from mining men. If we were to judge of the possibilities of the Province for the production of iron ore by some of the more optimistic of the earlier reports and papers descriptive of its resources, we would be led to look for the growth of a large iron mining industry as the country developed. But the better the deposits became known, the more they shrunk in volume and declined in quality; and we must attribute these earlier claims to the undeveloped state of the country and the natural optimism of early explorers in a comparatively unknown region.

While next to Ontario, Nova Scotia has to its credit the largest aggregate output of iron ore of any Province in the Dominion, the total tonnage from the earliest days to the present would not last a large modern plant very many years (in 1915, 840,394 tons of Newfoundland ore were used in Nova Scotian blast furnaces). Latterly, with the exhaustion of the workable deposits of better grade ore, production has declined until now it has reached the vanishing point. The extensive development of the Wabana iron ore field in Newfoundland, and the ease and cheapness with which Nova Scotian furnaces can secure a supply of suitable ore from that source, have also operated to decrease interest in the development of local supplies.

The production of iron ore in Nova Scotia since 1886 is as follows:—

	Short tons.		Short tons.
1886	44,338	1901	18,619
1887	43,532	1902	16,172
1888	42,611	1903	40,335
1889	54,161	1904	61,293
1890	49,206	1905	84,952
1891	53,649	1906	97,820
1892	78,258	1907	89,839
1893	102,201	1908	11,802
1894	89,379	1909	
1895	83,792	1910	18,134
1896	58,810	1911	22
1897	23,400	1912	30,857
1898	19,079	1913	20,436
1899	28,000	1914	
1900	18,940	1915	
		1916	

From the point of view of past production, the most important class of ore has been brown ore, or limonite. Such occurs notably in the contact deposits of Pictou, Colchester, and Hants counties, and as an alteration product from carbonates in an extensive series of fissures in the Londonderry field. Massive red hematite, of the Clinton type, low in iron and sulphur, but high in phosphorous and silica, is found typically developed at Torbrook; extensive beds of lower grade occur in Antigonish and Pictou counties. Magnetite is not met with in promising amounts except as a metamorphic product from hematite in the Torbrook-Nictaux and Clementsport fields. Siderite is found to some extent in Pictou and Colchester counties and at Londonderry, but has little importance.

At present the most important and promising iron ore field in the Province is the Torbrook-Nictaux basin in Annapolis county. The ores are hematite of the Clinton type and bedded magnetite metamorphosed from it, occurring in upper Silurian limestones and siliceous slates. Two workable beds are known to exist—the Leckie bed and the Shell bed. The ore of the Leckie bed is hematite for the most part, though magnetic in places; usually massive, but sometimes oolitic. The ore from the Shell bed exhibits two features not often found together; it is fossiliferous, and at the same time, highly magnetic.

Three mines have been operated in the district. The first was the Leckie mine opened in the bed of the same name, at the eastern end of the productive area. After reducing some 193,807 tons of ore, it was abandoned as worked out, the ore having been lost at a depth of somewhat more than 330 feet by the pinching in of the walls. The Martin mine has been opened up on the same bed as the Leckie, but at some considerable distance from it and near the western end of the field. The shaft at this mine has reached a depth of 500 feet, and cross-cuts connect it with the Shell vein. The total output of ore has been 102,100 tons, and when the mine shut down in 1913, there were in the stopes on the Leckie mine, above the 500 foot level, approximately 115,000 tons of ore, while the reserves developed on the Shell vein are placed at 250,000 tons. The Wheelock mine is situated about 2,000 feet northeast of the Martin mine, and is sunk on the Shell bed, on which it is the chief producer. The shaft is down only about 180 feet, but the bed is known by drilling to 382 feet.

Since the crude ore as mined from the two beds is too low in iron to be saleable, a concentrating plant to bring it up to merchantable grade was erected at Nictaux in 1911. The concentrates, shipped for export, ran 50 to 52 per cent iron, 13 per cent silica, 1·32 per cent phosphorus, and about 0·015 per cent sulphur. In 1913, operations ceased, and mine and plant have since been idle.

Experiments in magnetic concentration of the Torbrook ores have been made, but proved unsatisfactory on account of the large percentage of hematite contained in them.

In the Clementsport district, in the western part of Annapolis county, beds of magnetite similar in origin to the Shell bed at Torbrook are found. Little is shown of their extent or quality, though three of the occurrences have been worked in a small way in the past. At least two of the beds may be continuous for a long distance, and the field is regarded as a promising one for exploration.

The hematite beds of the Clinton type found in the Ordovician rocks in Antigonish and Pictou counties are of considerable extent, and would be very valuable if of good grade and quality. They are too low in iron and too siliceous to be workable under present conditions. Somewhat similar beds in the Cambrian rocks of the Mira valley in Cape Breton show some excellent ore, but the deposits are so narrow and intermittent that they have little value.

The mixed limonite-hematite-ankerite ores found in the Devonian slates and quartzites in the vicinity of Londonderry were for many years the chief source of supply for Nova Scotian iron furnaces. They are of some historic interest, also, on account of the fact that it was at Acadia mines in 1874 or 1875 that Dr. Siemens made his first commercial experiment in the direct conversion of iron into steel.

The ores lie in a long and well marked zone of fissuring in Devonian slates and quartzites near the contact with the various acid intrusives forming the central portion of the Cobequid hills. The fissured zone is occupied by a complicated system of veins of ankerite, siderite, etc., which has been oxidized in part to limonite and hematite. The oxides, which form the productive ore, are relatively superficial, rarely being found far below present drainage. They are especially low in sulphur and phosphorus, and were exceptionally pure in the upper working before the zone of carbonates was reached.

The total yield of brown ore alone from this field since 1849 is over 2,000,000 tons. No mining has been done for some years now, and the ore of commercial grade is believed to be practically worked out.

In Pictou, Hants, and Colchester counties, deposits of brown hematite are found forming irregular lenses and pockets at or near the contact of lower Carboniferous rocks with the underlying Pre-Cambrian, Silurian and Devonian formations. They are apparently in part replacements of limestone, in part fissure fillings. Similar deposits of small extent are also found in Cape Breton. Those at Brookfield in Colchester county and at a number of places in Pictou county have been mined in the past. The largest output recorded from any one deposit, however, is less than 50,000 tons; from most of them much less. Those that are known to be workable are now worked out, and while others will probably be found, it is not likely that they will add appreciably to the iron ore resources of the Province.

Small narrow veins and stringers of rich specular hematite are found at a number of places through the Province, especially in Guysborough county, and much attention has been attracted to them on account of the richness of the ore. None are known to be of workable size, and from the nature of their occurrence, it is not likely that large bodies of this kind will be found.

Bog ores and clay ironstone are of frequent occurrence, but only in limited quantity.

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VOL. I

DESCRIPTIONS OF PRINCIPAL IRON ORE MINES.

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IRON ORE OCCURRENCES IN CANADA.

VOL. I

DESCRIPTIONS OF PRINCIPAL IRON ORE MINES.

BRITISH COLUMBIA.

Texada Island Iron Mine.

Owners: Puget Sound Iron Company,
San Francisco, Cal., U.S.A.

The Puget Sound Iron Company acquired its Texada Island iron properties in 1873. The mines were operated intermittently between 1883 and 1907, during which time shipments of probably about 50,000 tons were made to the blast furnace at Irondale, Washington, U.S.A.

The iron ore deposits—the chief of which are known as the Prescott, Paxton, and Lake mines—are situated on the west coast of the island, about 3 miles north of Gillies bay. The ore is magnetite, and occurs in lenses of varying size, in an area 1½ miles long and one-half mile wide.

The ore-bodies are all exceptionally well situated for cheap mining and transportation. The distance of the main deposits from the coast range from a few hundred feet to a mile, with elevation above sea-level from 300 to 800 feet. The ore would be won by quarry, tunnel, and shaft development, and transported by surface trams to the loading pier.

The Prescott Mine and Vicinity.

The outcrops occur on a steep hillside, near the western end of the iron range, at elevations of from 300 to 580 feet above sea-level. The ore-bodies have formed along a contact between quartz diorite and limestone.

"They are enclosed in a roughly lenticular-shaped area, about 600 feet in length with a maximum width of 380 feet, in which are a few diorite and limestone cores.

"The development work consists of three large surface cuts on the principal magnetite lenses, and a shaft 150 feet deep sunk at the southerly tip of the mineralized areas. From the foot of the shaft a tunnel was driven in a northerly direction, through diorite, towards the main ore-body, which it reached at a distance of 215 feet. It was continued into the ore-body for a distance of 65 feet, and was subsequently extended southwards to meet the sloping surface. A second and shorter tunnel has been driven into the magnetite 250 feet higher up.

"As far as can be learned, the following shipments have been made from this mine:—

"Prior to 1884, ore was shipped, but the amount cannot be ascertained.

"Between 1884 and 1888 some	5,500	tons	were	shipped.
In 1889	1,600	„	„	„
„ 1901	2,500	„	„	„
„ 1902	6,290	„	„	„
„ 1903	2,290	„	„	„
	18,180			

"The Annual Reports of the British Columbia Minister of Mines record no shipments since 1903.

"The main magnetite mass is roughly crescentic in outline, has a length of 300 feet, with an average width of about 80 feet; and has been proven by a tunnel, to extend downwards for a distance of 430 feet below the highest outcrop. The dimensions in depth are not known, as the tunnel ends in ore after penetrating it for a distance of 75 feet.

"In addition to the main mass, several smaller lenses occur in the same altered area, two of which have been opened up by surface cuts."

The largest of these outcrops is a rounded mass about 75 feet in diameter occurring in the limestone. The third ore-body, as developed, is 100 feet long by 20 feet wide, and occurs in quartz diorite.

The magnetite is coarsely crystalline and is rarely free from impurities. Marcasite, pyrite, chalcopyrite, garnet, hornblende, epidote, quartz, and calcite are the associated minerals. A rough sample on the main ore face gave:—

Iron	64·30	per cent.
Copper	0·14	„
Sulphur	0·303	„

The light-coloured areas, composed mainly of quartz and calcite, were excluded from this sample.

"West of the Prescott mine, a number of magnetite lenses of moderate sizes occur along the diorite-lime, and farther on along the porphyrite-lime contacts, the larger having a length of 90 feet and a width of 20 feet. Lenses have also formed at a few points along the small outlying diorite stocks and dikes. A lens 57 feet long and 20 feet wide occurs at one point forming the continuation of a diorite dike. The magnetite in this lens is remarkably free from both sulphides and non-metallic impurities. It contains a small percentage of manganese. It yielded on assay, iron 68·20 per cent, copper none, sulphur trace, manganese 0·08 per cent.

"North of the Prescott mine three large and several small lenses of magnetite occur in one of the limestone bays. The most westerly and largest of these has formed entirely in limestone. It has a length of 250 feet and an average width of about 50 feet. The second lens has a length of 160 feet, a width of 40 feet, and has formed along the contact. The third lens has developed partly in diorite and partly in limestone, and has a length of 200 feet and a width of about 70 feet. The ore, judging from the surface exposure, is of superior quality, and the percentage of sulphides present is very small.

"Southwest of the Prescott a mineralized area in the quartz-diorite about 75 feet across, is exposed in a cut on the tramway from the mine to the coast. The area contains a narrow lens of magnetite, but consists mainly of epidote, garnet and small bunches of magnetite. The percentage of sulphides present, mostly iron pyrites, is high."

The Paxton Mine and Vicinity.

"The Paxton ore-body situated at the eastern boundary of the quartz-diorite stock, about 3,500 feet east of the Prescott mine, ranks next to the latter ore-body in size. It has a length of 290 feet, a maximum width of 200 feet, and an average width of about 150 feet. It has developed entirely in the quartz-diorite near its contact with porphyrite.

"The southern part of the ore-body outcrops on a steep slope about 60 feet in height, the lower part of which is diorite, and the upper part magnetite. Two short open-cuts about 80 feet apart through the diorite, expose the diorite-magnetite contact. A tunnel 40 feet in length has been driven from the end of the most easterly of the cuts through the solid magnetite. The attitude of the magnetite lens is nearly vertical."

The ore is coarse-grained and contains a larger percentage of sulphides, mostly iron pyrites, than usual. A sample taken along the tunnel yielded:—

Iron	59·40	per cent.
Copper	0·30	"
Sulphur	1·07	"

To the north of the Paxton there are several lenses of magnetite of good quality exceeding 50 feet in length. Farther north along the lime diorite contact there are several small magnetite lenses, two of which are each about 60 feet long. East of the Paxton there is a rounded mass of magnetite in the limestone along with several smaller lenses.

The Lake Mine and Vicinity.

"An important body of magnetite occurs at the Lake mine, situated near the eastern known limit of the iron range, about 1,300 feet east of the Paxton mine. A magnetite mass measuring 180 feet in length, with an average width of 130 feet, has formed here in the porphyrite at the bottom of an angular limestone bay. The magnetite is bordered on three sides by porphyrite, and has apparently developed mostly in that rock. Limestone occurs on the north, but is separated from the magnetite mass by an irregular area consisting mostly of garnet and epidote. Pyrite, pyrrhotite and magnetite in scattered grains and bunches are also present, and the latter in two places forms small lenses.

The magnetite in this ore-body is finer-grained than in the other large masses, and is freer from iron and copper sulphides."

A rough general sample from the magnetite cliff yielded:—

Iron	57·50 per cent.
Sulphur	0·046 „
Copper	Trace.

A buried lens of magnetite was encountered in the development of a copper deposit 250 feet to the northeast of the main body. A line of narrow lenses about 1,000 feet in length occurs south of the Lake mine in the porphyrite. The most northerly lens is 220 feet long, with a width varying from 10 to 20 feet. A sample yielded:—

Iron	69·40 per cent.
Sulphur	0·01 „
Copper	None.

The other lenses measure respectively 50 and 84 feet in length, and 10 and 20 feet wide.

The ore in all these lenses is fine-grained and remarkably pure.

Ore Reserves.—The total quantity of ore in the various outcrops is difficult to estimate as practically no development has been done below the surface except in the Prescott mine.

"For the purpose of making a rough estimate, it is assumed that the lenses extend downwards for a distance equal to their exposed surface length. The Prescott ore-body with a surface length of 300 feet has been proven to extend downwards for a distance of 430 feet, and at the low level is still strong and must descend considerably farther.

"The tonnage in the main Prescott ore-body above the lower tunnel is estimated at 1,366,400 tons. The three large lenses in the limestones northeastward from the Prescott, assuming that they persist to a depth equal to their surface length, would yield 993,600 tons. The Paxton ore-body should yield 1,607,200 tons, and the Lake ore-body 504,000 tons. The total tonnage in the six ore-bodies, estimated on the basis adopted, amounts to *4,~~521,~~* 476 *200 tons.* (R. G. McConnell).

"No account is taken in this estimate of the numerous small lenses, from 20 to 100 feet or more in length, occurring along the range. Some of these are surrounded by large areas of intense alteration and mineralization, and the concealed portions may be much larger than the small outcrops appear to indicate.

"It is also unlikely that the lenses cut by the present surface represent the lowest tier formed. It is more probable that they are followed in depth along the contacts by other lenses, and the tonnage given above may be multiplied several times before the iron resources of the district are exhausted."

General Character of Ore.—"The magnetite lenses vary greatly in the amount of impurities they contain, more especially in regard to the sulphides. The rocks in which the lenses formed appear to have had some influence on the character of the ore, as those in the porphyrite are the purest on the whole, and those in the diorite the most impure. The lenses formed in the limestone are variable, some being nearly free from sulphides while others contain large percentages.

"The following assays of the three principal lenses were made in the laboratory of the Mines Branch from samples collected by Mr. E. Lindeman:—

	Prescott Ore-body. Lower tunnel.	Paxton Ore-body. 45-ft tunnel.	Lake Ore-body. Average of ore.
Silica	4·37	4·47	8·33
Iron	63·27	64·48	59·57
Alumina	1·18	0·66	1·71
Lime	2·58	1·32	3·82
Magnesia	1·05	1·13	1·05
Copper	0·09	0·22	0·08
Sulphur	0·347	1·866	0·137
Phosphorus	0·007	0·003	0·032

"These assays are probably fairly representative of the general run of the ore in the large masses. The phosphorus content in these and in numerous other recorded assays is low, usually well below the Bessemer limit. The copper content is also small as a rule, but in limited portions of the Prescott ore-body, and possibly in other lenses the amount present rises to over one per cent.

"Sulphur contained in the iron sulphides, pyrite, marcasite and pyrrhotite, and the copper sulphide, chalcopyrite, is the principal deleterious impurity. The Paxton ore-body is impregnated throughout with sulphides in grains and small aggregates. In the Prescott ore-body the distribution is more irregular, some areas carrying considerable percentages, while others are nearly free. The Lake mine ore-body is exceptionally free from sulphides except along its northern border.

"The small lenses vary from nearly pure magnetite to masses made up largely of sulphides. A sample from the line of lenses south of the Lake mine, assayed over 69 per cent iron, with no copper and only 0·001 per cent sulphur. A sample from a moderate sized lens west of the Prescott mine proved almost equally pure. It contained 68·20 per cent iron, with no copper and only a trace of sulphur."

The comparatively high percentage of sulphur in the Paxton ore-body and in portions of the Prescott will necessitate special treatment of the ore to make it fit for blast furnace use. The percentage in the Lake ore-body, in portions of the Prescott, and in a number of the smaller lenses is low, and the ore from these can possibly be marketed as mined.

References:—
R. G. McConnell, Geological Survey, Memoir 58, pp. 81–91, 1914.
E. Lindeman, Mines Branch, Rep. No. 47, pp. 21–24, 1907.
W. M. Brewer, Report to Pacific Steel Company, 1902.
Report of Minister of Mines, B.C., 1902, pp. 225–228.

The Glen Iron Mine.

Agent: S. C. Burton, Kamloops, B.C.

This property is situated at Cherry bluff on the south side of Kamloops lake, 13 miles west of Kamloops, and adjoining the Canadian Pacific railway.

It consists of 165 acres held under Dominion Crown grant, giving the surface and all iron deposits, also two mineral claims containing about 30 acres located under provincial laws adjoining the above, the whole having a frontage of about three-quarters of a mile on the Canadian Pacific railway. In addition there are two full-sized mineral claims, each 1500 by 1500 feet, located chiefly on the Crown granted land, but each covering a strip about 180 feet wide outside the Crown grant.

These ore deposits have been worked intermittently between the years 1889 and 1901. The ore was shipped to Tacoma, and to the Revelstoke Smelting Works.

From an open-cut on the main vein shipments of ore to the amount of 12,000 tons have been made. Later the ore was stoped at an elevation of about 150 feet above the upper terminal of the aerial tram. The vein here is about 15 feet wide. A tunnel has been run on the vein at the level of the upper terminal, and is now in about 125 feet; cross-cuts were run at 75 feet, and the face of the tunnel shows about 15 feet of ore.

The iron deposits consist of a number of veins or lodes, the general direction of which is northeast, and are vertical or dip northeast at high angles. One of the largest of these is situated about 700 feet horizontally from the Canadian Pacific Railway track, and about 450 feet above the same, and has been worked for several years, the ore being run down to the railway by means of an aerial tram.

McEvoy gives the following section of the veins:—

No. 1. An opening a few feet from the railway, filling an irregular, angular fissure from 2 to 6 feet in width. Between 1,000 and 1,500 tons mined.

No. 2. 300 feet south of No. 1, a deposit of 4 feet of good ore with 5 feet mixed ore and country rock.

No. 3. 500 feet southward from No. 2 a large deposit 14 feet of good ore, with 10 feet of mixed.

No. 4. 30 feet northwest of No. 3, 12 feet of ore.

No. 5. West of No. 4, in vein 3 feet thick.

No. 6. Southwest of No. 5, numerous croppings of good ore undeveloped. At a low estimate 10 per cent of the mass here is ore.

No. 7. Northwest of No. 3, a vein 4 to 10 feet thick. This is the principal source of output at present, and is connected with the railway by an aerial tramway.

The Glen mine ore is magnetite, and has the following composition:—

	No. 1.	No. 2.	No. 3.
Iron	64·81%	62·03%	63·24%
Moisture	Trace.	Trace.	Trace.
Silica insoluble matter	4·21	3·85	4·05
Manganese	Trace.	Trace.	Trace.
Alumina	3·78	3·08	3·05
Lime	1·00	3·85	3·46
Magnesia	0·39	0·24	
Sulphuric acid	0·158	0·170	0·17
Phosphoric acid	Trace.	Trace.	Trace.
Carbonic acid	None.	1·03	0·82
Combined water	0·66	0·55	0·48

Tested also for silver, copper, tungsten and titanium, but none found.

The iron reserves have been estimated at 8,000,000 tons, but the development work has not been extensive enough to prove up any such tonnage.

References:—

Report, C. W. Drysdale, Geological Survey of Canada.
Report furnished by S. C. Burton, Kamloops, B.C.
Geological Survey of Canada, Vol. V, 1890–91, p. 85 SS.
Geological Survey of Canada, Vol. VI, 1892-93, p. 79 S.
Geological Survey of Canada, Vol. VII, 1894, p. 65 S.
British Columbia, Minister of Mines Report, 1901, p. 1079.

ONTARIO.

Atikokan Iron Mine.

Owners: Atikokan Iron Company, Limited,
Port Arthur, Ontario, Canada.

The Atikokan iron mine is located on Mining locations E10, E11 and E12 on the Atikokan river, in the district of Rainy River. A spur 3 miles long connects the mine with the main line of the Canadian Northern railway at Iron Spur, 128 miles west of Port Arthur. (See maps Nos. 340 and 340A).

The Atikokan iron deposits were discovered in 1882 by Jim Shogonosh, an Indian trapper in the employ of Mr. G. McLaurin, of Savanne, Ontario. The latter interested Messrs. McKellar Bros. of Fort William, who applied for and acquired from the Government what are now known as Mining Locations E10 and E11. In 1905 the property was taken over by the present owners, The Atikokan Iron Company, Limited, of Port Arthur.

With the exception of a trench cut across the ore-bearing ridge in 1887 no development work was done until 1900, when a tunnel 5 feet by 6 feet was driven through the hill, a distance of 284 feet. In 1901 six diamond drill holes were put down. The tunnel was enlarged in the years 1907 and 1911. In 1911 and 1912 four additional tunnels were driven into the hill. Three exploratory shafts were started in 1912. One was discontinued at a depth of 47 feet, but Nos. 2 and 3 were sunk 150 and 126 feet respectively, and from the bottom of each of the latter a drift was driven across the ore-bearing zone. Since the completion of this work in 1913 all operations at the mine have been suspended.

Mining operations to supply the company's blast furnace at Port Arthur commenced in 1907 when a small output was shipped. Since then the mine has been operating and shipping ore during the years 1909, 1910, and 1911.

The most conspicuous feature of the Atikokan property is a steep narrow hill with a length of 3,800 feet, a maximum width of 400 feet, and a maximum elevation above the swamp, which surrounds it on all sides, of 100 feet. This hill is composed chiefly of dark basic rocks with which are interbedded irregularly-shaped, roughly lenticular, overlapping bodies of magnetite, some of which are impregnated with sulphides.

The irregularities in width and in chemical composition of the ore-lenses are illustrated by the following information secured from exploratory workings.

"A" tunnel is the most westerly of those driven in the ore-bearing hill. It cuts three lenses of ore with widths respectively of 7, 26, and 8 feet. The analyses of the ore in these lenses show the following range:—

Iron	45·1 per cent	—51·25 per cent.
Silica	4·9 ”	—15·40 ”
Sulphur	14·9 ”	—18·80 ”
Phosphorus	0·009 ”	— 0·06 ”

"B" tunnel is located 1185 feet east of tunnel A. It cuts 6 lenses of ore with widths of 12, 8, 24, 22, 9, and 5 feet respectively. The analyses of the ore showing in these lenses range as follows:—

Iron	45·9 per cent	—59·0 per cent.
Silica	8·3 ”	—19·4 ”
Sulphur	2·2 ”	—12·3 ”
Phosphorus	0·9 ”	— 0·85 ”

PLATE I.

Atikokan mine: general view of ridge.

PLATE II.

Open-cut, Atikokan mine.

PLATE III.

Open-cut, Atikokan mine.

"C" tunnel (the original exploratory tunnel) is 450 feet east of B tunnel. This cuts 2 ore-lenses with widths of 47 and 42 feet respectively. The ore shipped from the first-mentioned lens was of the following average composition:—

Iron	60·00	per cent.
Silica	8·50	"
Sulphur	2·01	"
Phosphorus	0·11	"

The average analysis of the ore cut in the northerly lens is as follows:—

Iron	47·68	per cent.
Silica	17·51	"
Sulphur	2·30	"
Phosphorus	0·193	"

"D" tunnel located 450 feet east of C tunnel cuts 2 lenses of ore with widths of 40 and 33 feet respectively. The ore mined from the first, or southerly one, averaged as follows:—

Iron	59·57	per cent.
Silica	8·41	"
Sulphur	2·17	"
Phosphorus	0·11	"

The section of the northerly lens exposed in the tunnel is of the following composition:—

Iron	59·40	per cent.
Silica	8·10	"
Sulphur	0·61	"
Phosphorus	0·041	"

"E" tunnel is located 510 feet east of tunnel D. This cuts 2 lenses of ore with widths of 47 and 17 feet respectively, and separated by 19 feet of rock. The average analyses of the sections of ore exposed in the tunnel are as follows:—

	South Lens.		*North Lens.*	
Iron	48·86	per cent.	56·18	per cent.
Silica	15·90	"	11·05	"
Sulphur	12·90	"	1·97	"
Phosphorus	0·169	"	0·157	"

The ore as exposed in the workings is a hard, dense magnetite, difficult to mine, and of a refractory nature. Associated with it are pyrite and pyrrhotite in varying proportions, and also a little chalcopyrite. Phosphorus runs above the Bessemer limit, and nickel and copper are present in minute quantities.

As noted before, mining operations were carried on during the years 1907, 1909, 1910, and 1911. The bulk of the ore shipped has come from an open-cut about 300 feet long, 40 feet wide, and 60 feet deep, on the south side of the hill at C tunnel. Smaller quantities have come from a small open-cut at the south entrance of D tunnel and from exploratory work.

The total shipments from the mine to date amount to 86,433 long tons, and the average analysis of this ore was as follows:—

Iron	59·85	per cent.
Silica	8·68	"
Sulphur	2·01	"
Phosphorus	0·11	"
Alumina	1·51	"
Lime	3·00	"
Magnesia	2·54	"
Manganese	0·11	"
Copper	0·12	"
Nickel	0·11	"
Titanium	None.	

Because of its objectionable sulphur content, all this ore has to be roasted to prepare it for use in the blast furnace.

As regards the quantity of ore available for mining here, there are without doubt several millions of tons scattered through the ore-bearing zone. But the ore occurs in bodies very irregular, both in outline and in distribution, through the enclosing rock, causing the relative proportion of rock and ore over a given width of the ore-belt to vary greatly within even short distances. These considerations make any accurate estimate of tonnage of ore recoverable almost impossible. In addition, the variable and, in places, very high sulphur content, a matter seriously affecting the value of the ore, would have to be taken into consideration in any estimate of tonnage of *commercial* ore.

The surface equipment consists of three 100-H.P. boilers, furnishing power for operating the plant, one air compressor (981 cu. ft. per minute), one Austin gyratory crusher, crushing to 2½ inch size, with capacity of 50 tons per hour, necessary drills, ore cars, etc., blacksmith shop, office, warehouse, etc.

Camp accommodation for 100 men is provided.

References:—

J. Dix Fraser for Atikokan Iron Company, Port Arthur, Ontario, 1914.
F. Hille, Mines Branch, Ottawa, Report No. 22.
A. H. A. Robinson, Mines Branch, Summary Report, 1914.
Annual Reports, Ontario Bureau of Mines, 1900–1915, inclusive.

Atikokan mine, mine buildings.

Helen Mine (Hematite Deposit).

Owners: Algoma Steel Corporation, Limited, Sault Ste. Marie, Ontario, Canada.

The band of iron formation on which Helen mine is located has a length of 1¾ miles, and for three-quarters of a mile the width averages about 1,200 feet. It is composed chiefly of cherty and granular silica, usually massive, but in places slightly banded. In many places it has been badly crushed and brecciated. In subordinate amount there occur segregations of siderite, göthite, and hematite, which exploration has shown lie exclusively along the south side of the iron range. With the chert, granular silica and siderite, there is usually associated more or less pyrite; and in places, deposits of pyrites of merchantable grade and of considerable size exist.

Helen mine is situated on mining claims Nos. 68 and 69, in the southern part of township 29, range XXIV, in the district of Algoma. It is 11 miles distant by rail from Michipicoten harbour on Lake Superior, where is located the ore dock of the Algoma Central and Hudson Bay railway, at which lake vessels of 21 feet draft may tie up.

This mine has to its credit the largest iron ore production of any mine in the Dominion of Canada, the shipments of iron ore from the commencement of mining operations in 1900 to the end of 1915 having been 2,263,522 gross tons. Besides this there was shipped from 1906 to 1915 inclusive, 37,572 gross tons of iron pyrites. The ore-body has been almost completely worked over, and the comparatively small tonnage extracted during recent years has come principally from caved ore, and from pillars left when the ore was extracted by stoping. The ore is classified as an Old Range non-bessemer hematite, and because of its porous texture it is easily reduced in the blast furnace. Average analyses of 1914 shipments are as follows:—

	Helen No. 1.	*Helen No. 2.*
Iron	56·79 per cent.	57·76 per cent.
Silica	6·16	5·90
Sulphur	0·264	0·391
Phosphorus	0·095	0·092
Alumina	0·900	0·880
Lime	0·240	0·230
Magnesia	0·152	0·140
Manganese	0·170	0·165
Moisture	4·00	4·00

Guaranteed analyses for 1915 shipments are as follows:—

Helen No. 1.	Iron, 55%	natural.	Sulphur under 0·200%	dried.
„ No. 2.	„ 53%	„	„ „ 0·400%	„

Railway freight, in 1914, to Michipicoten harbour on Lake Superior was 50 cents per ton, and to Sault Ste. Marie, Ontario, $1 per ton.

All the mine plant is operated by electric power generated 12 miles distant at High Falls on the Michipicoten river. The hoisting and crushing equipment will handle an output of about 2,000 tons per 24 hours. The mine equipment includes a 150-H.P. electric hoist for skips, a 35-H.P. electric hoist for cage, a No. 6 Austin gyratory crusher, a 24-inch trough belt ore conveyer 240 feet long, four electric turbine pumps with a capacity of 1,500 gallons per minute against a 500-foot head, and a completely equipped machine shop for making all mine repairs.

A camp with water and sewage systems, and lighted by electricity and capable of accommodating about 500 people is maintained by the operating company.

The mine was developed from two shafts. No. 1 shaft sunk to the sixth level, a depth of 435 feet, is used for cage and ladderway. No. 2 shaft, started from about the same level as No. 1 shaft, was sunk as a 2-compartment shaft to the sixth level, and as a 4-compartment shaft to the ninth level at a depth of 651 feet. In 1912 the portion of No. 2 shaft above the fourth level was abandoned, and a new incline was driven from there to surface, making the total depth of the present No. 2 shaft 821·7 feet.

Probably about 45,000 feet of drifting, cross-cutting and raising was done in opening up the mine on the eight levels which have been worked. Prior to 1904 diamond drilling to the extent of 3,425 feet was done.

The main ore-body lay at the eastern extremity of a small lake called Boyer lake, which has been pumped out. In plan the deposit was roughly elliptical with, on the upper levels, a longer axis of 700 feet and a shorter axis of 200 feet. As greater depth was reached the major axis decreased in length, but at the same time the minor axis increased, with the result that about the same floor area of ore existed on each level except the eighth, where it is probably less than half as large as on the levels above. The ore-body had a pitch of about 60 degrees to the northeast. The vertical extent was about 700 feet.

On the south side the ore-body was bounded by country rock to the fifth level, and from that to the eighth by siderite; on the east it merged into lean ore generally; on the north it was bounded by a zone of iron-stained silica, succeeded by brecciated chert; and to the west it was bounded by a white to yellowish clayey dike, which, away from the ore-body, is really a medium-grained diabase. This dike appears to form the barrier in the iron formation against which the ore-body was deposited.

An interesting, though unfortunate feature of this deposit was the presence in it of pockets of pyritic sand varying in size from those containing a few cubic feet to others varying from 30 to 40 feet in their greater dimensions. These pockets were not numerous on the first level, but on succeeding levels the pyritic zone increased in size, thus raising the sulphur content

Helen mine, Michipicoten.

Crusher plant and shafts, Helen mine, Michipicoten.

of the ore hoisted, and resulting in a large tonnage of ore having to be left unmined.

To the west of the clayey dike lay a smaller ore-body first picked up on the third level at a depth of 280 feet. This has been worked on the third, fourth, fifth, and sixth levels. A considerable proportion of this ore was of Bessemer grade (in marked contrast to that of the main ore-body), but on the lower levels the ore was badly contaminated with pyrites.

The upper portion of the ore-body was mined in benches, and the ore was loaded into railway cars by steam shovels. From track level to the second level, at a depth of 164 feet, the greater portion of the ore was handled by milling methods. On the third, fourth, fifth and sixth level the ore was extracted by underhand stoping methods, pillars being left at intervals of about 50 feet to support the "back". On the seventh and eighth levels the ore is won by slicing and caving from sub-levels.

References:—
A. P. Coleman, and A. B. Willmot, Ontario Bureau of Mines, 1902, pp. 152–165.
A. P. Coleman, Ontario Bureau of Mines, 1906, p. 187.
R. W. Seelye, Journal of Canadian Mining Institute, 1910, pp. 121–134.
Plans and records furnished by Mines Department of Lake Superior Corporation, Sault Ste. Marie, Ontario, 1914. (George S. Cowie, Secretary.)
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 202.
Annual Reports, Ontario Bureau of Mines, 1900–1915 inclusive.

Magpie Mine.

Owners: Algoma Steel Corporation, Limited., Sault Ste. Marie, Ontario, Canada.

The Algoma Steel Corporation's Magpie mine is located in the south-east quarter of township 29, range XXVI, in the district of Algoma. It is connected by a nine-mile spur with the Michipicoten division of the Algoma Central and Hudson Bay railway, by which access is had to Michipicoten harbour on Lake Superior, 26 miles distant, and to Sault Ste. Marie, 182 miles distant.

The claims comprising the Magpie mine property were staked in 1909 on several showings of magnetite. Exploration by trenching, stripping and test-pitting, and by diamond drilling was undertaken the same year, and was continued until the fall of 1910, this work showing the deposits to consist essentially of siderite, portions of which had been altered to magnetite.

In 1910 the sinking of a four-compartment shaft was commenced, and in 1911 the erection was undertaken of a roasting plant for the production of a marketable ore from the siderite, which had been shown to have an iron content of about 35 per cent, and an objectionable amount of sulphur.

The roasting plant was put in operation in December 1912, and was operated until October 1913, when it was dismantled to be replaced by a plant designed along lines suggested by the experience of the previous ten months. The new roasting plant went into operation in May 1914, and continued until October 31, when mining operations were suspended indefinitely on account of the depression in the iron and steel trade. In May 1915 mining operations were resumed, and the roasting plant, with some modifications, was again put in commission, since which date operations have proceeded continuously.

The ore in this deposit is a hard, dense, fine-grained siderite, most of which is more or less altered to magnetite. The colour varies from pale yellow, through grey, to black according to the proportion of magnetite present. Pyrite is rather plentifully present, always in such an amount as to give an undesirable sulphur content.

The ore-bodies stand about in the vertical and have a general east and west trend. They are enclosed in Keewatin rocks, greenstone being found usually on the north, and quartz-porphyry schist on the south.

Access is had to the mine by a four-compartment shaft. Two compartments of this shaft are used for ore-skips, one for a cage, and one for a ladderway and air, water and power lines.

Mining operations have been carried on on the first and second levels, the ore-body being developed for a length of 1,300 feet. The ore is mined by back-stoping from sub-levels. As all the ore mined has to pass through the roasting plant before shipment, no accurate record of tonnage of ore hoisted is kept. The output of the roast plant averages about 19,000 tons per month.

The total shipments of roasted ore to date have been as follows:—

In 1913	19,935	gross tons.
1914	98,070	"
1915	118,666	"
Total	236,671	"

The average analysis of the 1916 shipments of Magpie roasted ore is as follows:—

Iron	50·10	per cent.
Silica	9·14	"
Sulphur	0·136	"
Phosphorus	0·013	"
Alumina	1·28	"
Lime	7·96	"
Magnesia	8·04	"
Manganese	2·74	"
Loss by ignition	None.	

Plate VII.

Magpie mine: general view.

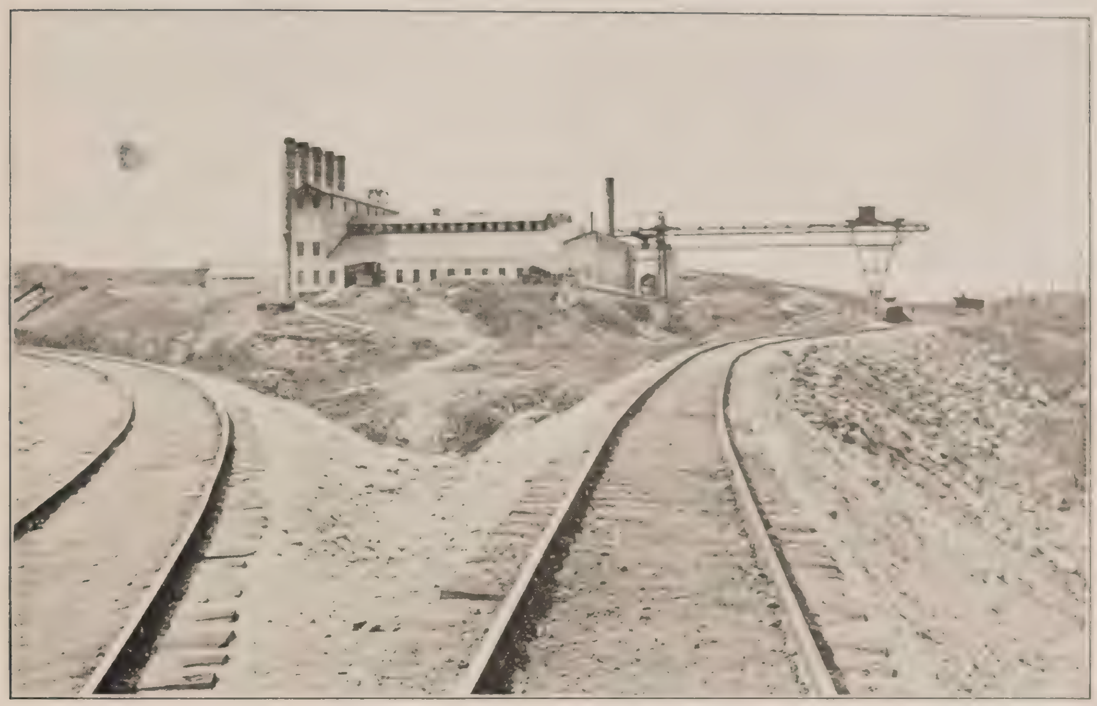
Plate VIII.

Magpie mine: head frame and roaster stacks.

Plate IX.

Magpie mine: discharge end of cooling tube.

Plate X.



Magpie mine: roasting plant and ore bridge.

Plate XI.

Magpie mine: ore bridge and stock pile.

The composition of the raw ore is, according to the analysis of a sample taken by Mr. C. W. Knight of the Ontario Bureau of Mines in 1913, as follows:—

Insoluble	3·40	per cent.
$FeCO_3$	53·20	"
FeO	3·50	"
Fe_2O_3	8·40	"
$CaCO_3$	9·79	"
$MgCO_3$	11·57	"
$MnCO_3$	4·60	"
Iron (metallic)	34·30	"

The freight rates paid in 1914 were 50 cents per ton to Michipicoten harbour (including loading into boats), and $1 per ton all rail to Sault Ste. Marie, Ontario. The established lake freight from Marquette, Michigan, governs on shipments from Michipicoten harbour to Lake Erie ports.

The air compressor, a motor generator set, machine shop and blacksmith shop adequate for the requirements of mining, crushing and roasting operations, are located conveniently to the shaft.

The head frame is of steel and is 75 feet high. The crushers are three in number, one No. 8, and two No. 5 Austin gyratories. Troughed belt conveyers move the ore to the steel-bottomed stock bins, of which there are six, each with a capacity of 5,000 cubic feet.

The roasting kilns are six in number, each 8 feet in diameter and 125 feet long. At the upper end of each is a concrete dust chamber through which the waste gases pass on their way to the concrete stacks of which there are six, one for each kiln.

The fuel used for firing the kilns is pulverized coal, and the necessary machinery for crushing and pulverizing this is located adjacent to the roasting plant.

Rotary cylindrical coolers convey the hot ore to the stock yard, where it is distributed by an electric trolley bridge with drag-bucket of 80 cubic feet capacity.

All the mine equipment is operated by electricity generated at Steephill falls on the Magpie river, about 12 miles distant. The power line is connected at Helen mine with the Algoma Power Company's line from High falls on the Michipicoten river, so that power may be secured from that source in case of emergency.

The operating company has provided accommodation in camps and cottages for about 300 people. The camp is provided with water and sewage systems, and is lighted by electricity.

References:—
E. T. Corkill, Ontario Bureau of Mines, 1912, p. 113.
E. T. Corkill, Ontario Bureau of Mines, 1913, p. 106.
T. F. Sutherland, Ontario Bureau of Mines, 1914, p. 124.
Jas. Bartlett, Ontario Bureau of Mines, 1915, p. 105.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 199.
D. E. Keeley, Porcupine Branch Canadian Mining Institute, 1914.
Plans, records and information supplied by Mines Department, Lake Superior Corporation, Sault Ste. Marie, Ontario (Geo. S. Cowie, Secretary), 1915.

Moose Mountain Mine.

Owners: Moose Mountain, Limited, Sellwood, Ontario, Canada.
Property and Location.

The property of Moose Mountain, Limited, includes a number of low grade iron ore deposits included in an area of about 4 square miles, which extends from lot 6, concession III of the township of Hutton, district of Sudbury, northwesterly for 4½ miles into lot 1, concession VI of Kitchener township. The greater number of these deposits are grouped around the village of Sellwood.

Sellwood lies about 35 miles north of Sudbury, its nearest important centre, and is connected by a short branch line with the Toronto-Port Arthur line of the Canadian Northern railway, at Sellwood Junction. A few miles south of the French river, a six-mile spur from the main line of the Canadian Northern has been constructed to Key inlet on the Georgian bay, making a rail haul from Sellwood to Key harbour of 82 miles.

History.—Although the existence of deposits of banded iron formation here had been known since the early nineties, it was only in 1901 the exploration of these was undertaken. The first development work was done in 1906, and was on No. 1 deposit, and during 1907 a small crushing plant was installed at that point. The first shipment was made in 1908 when railway communication was established. The unfavourable reception this ore was accorded because of its low iron content led to the installation early in 1909 of a magnetic cobbing plant. Sufficient success attended the cobbing process to induce the owners to erect an enlarged cobbing plant, which was completed in 1910. The enlarged plant was in operation from August 1910 to May 1911, when it was closed down owing to unsatisfactory market conditions and complaints made by the buyers that the ore contained a too high percentage of fines. It was, therefore, necessary to screen the ore before further shipment could be made. This resulted in a considerable loss of magnetite in the fines.

The cobbing plant was put in operation again in 1912, and was operated until June 1914. The fines from this plant since 1912 have been taken care of in a Gröndal concentrating and briquetting plant erected that year for the purpose of treating the low grade siliceous ore comprising the major proportion of the company's ore reserves. Experimental operations have been carried on intermittently at this plant since 1912, but as yet the plant has not been operating on a commercial basis.

Ore Deposits.—The ore deposits lie in a series of metamorphic schists of Archæan age, the chief constituents of which are hornblende, chlorite, feldspar and quartz. The more basic members of this series are prevailingly dark-green in colour, owing to the large amount of hornblende and chlorite present; while others, chiefly made up of feldspar and quartz, are of a lighter colour. The deposits have been upturned, faulted and folded together with these schists; their general strike and dip being, therefore, conformable to that of the latter, which generally is in a northwesterly direction, with a dip varying from 70 to 85 degrees towards the east. Locally, however, where the folding has been very intense, marked divergences in strike and dip frequently occur.

The existence of 11 ore deposits of all grades has been established by surface and diamond drill exploration and by magnetometric survey (see map No. 208c). These are divisible into two classes or types:—

Type A (including deposits Nos. 1 and 5. See map No. 205) consisting of magnetite associated with hornblende, pyroxene and epidote; and

Type B (including all deposits except Nos. 1 and 5. See maps Nos. 205, 206, 207, 208, 208a and 208b) consisting of fine-grained siliceous magnetite interbanded with siliceous material of both cherty and quartzitic texture.

Because of their irregular mineralogical composition, it is almost impossible to state what is the average iron content of deposits of type A. From them it has, however, been demonstrated by operations extending over a period of several years that there can be secured by magnetic cobbing a non-bessemer concentrate running about 55 per cent iron.

Deposits of type B average about 37 per cent iron, 45 per cent silica, and 0·055 per cent phosphorus.

Mining Operations.—Mining operations have so far been confined to deposits Nos. 1 and 5, which consist chiefly of ore of type A, that is, of magnetite associated with hornblende and epidote. The ore, until 1912, was won exclusively from No. 1 deposit from an open-cut with a face 60 to 70 feet high, and was trammed to a large bin discharging to a belt conveyer which delivered it to the cobbing plant. Since 1912 the ore from No. 1 deposit has been milled through raises and trammed on the 100-foot level to a 3-compartment shaft which is sunk to a depth of 180 feet.

At the cobbing plant the ore is crushed in a 24 by 36 inch jaw crusher. From the crusher the ore is conveyed to a storage bin of 800 tons capacity, whence it is fed to No. 4 gyratory crushers. The product from these crushers is screened to pass a 1-inch ring, the oversize passing to a Symons

48-inch disc crusher. The crushed ore is next passed over Ball and Norton single drum magnetic separators, giving two products, concentrates and tails. The concentrates are screened on an 8-mesh screen to rid them of dust.

Details as to yearly shipments of concentrates (which total 323,049 gross tons to the end of 1915), and average analyses of the same, are shown in the following statement:—

Yearly Shipments of Concentrates, 1908-1914.

Year.	1908	1909	1910	1911	1912	1913	1914
Shipments. Gross tons.	2,577	26,199	71,784	6,749	49,339	95,518	23,334
Analysis:—							
Iron	....	55·45%	54·60%	....	54·30%	55·50%	54·45%
Silica	....	12·67	14·29	....	14·54	14·15	14·55
Sulphur	....	0·074	0·029	....	0·031	0·027	0·036
Phosphorus	....	0·017	0·091	....	0·099	0·099	0·105
Alumina	....	1·58	1·92	....	1·83	2·03	2·09
Lime	....	3·77	3·82	....	3·97	3·26	4·00
Magnesia	....	3·52	3·64	....	3·64	3·06	2·83
Manganese	....	0·09	0·06	....	0·07	0·09	0·07
Loss by ignition	....	....	0·63	....	0·48	0·42	0·75

The dust from the No. 1 plant has, during recent years been ground, concentrated and briquetted at the Gröndal or No. 2 plant. Particulars as to shipments of briquettes during 1913 and 1914, and average analyses of the same are shown in the following table:—

Shipment of Briquettes and Analyses of same, 1913-1915.

Year.	1913.	1914.	1915.
Shipments, gross tons.	3013	5466	1680
Analysis:—			
Iron	63·03%	63·02%	63·02%
Silica	6·05	6·66	6·66
Sulphur	0·014	0·012	0·012
Phosphorus	0·028	0·037	0·025
Alumina	0·93	1·00	1·00
Lime	2·00	1·50	1·50
Magnesia	1·49	1·53	1·53
Manganese	0·06	0·08	0·08
Loss by ignition	None.	None.	None.

Freight Rates.—The freight rates existent in 1914 on iron ore shipments from Sellwood were as follows:—

To Sault Ste. Marie, all rail		$1.60
„ Parry Sound,	„ „	1.00
„ Deseronto,	„ „	1.55
„ Key Harbour	(including loading into boats to U.S. ports)	.55
„ „ „	(including loading into boats to Canadian ports)	.65

The lake freight from Key harbour to Lake Erie ports in 1913 was 40 cents, and in 1914 it was 35 cents.

Ore Reserves.—The ore reserves consist of deposits of type A, with an area of 71,000 square feet, and those of type B with an area of 3,185,000 square feet (see maps). Data for making a reliable estimate of tonnage of either type are insufficient.

It being evident that only a limited tonnage of concentrates of the grade already produced is still available from deposits Nos. 1 and 5, the owners realize that the problem to be solved is the economical production of a marketable product from deposits of type B. The total area of all deposits is about 3,256,000 square feet, and assuming an average specific gravity of 3·8 for the ore, the deposits, for each 100 feet in depth, should yield about 38,665,000 tons of siliceous ore; and with a proven depth of at least 300 feet for portions of two deposits, it is probable that the figures of tonnage just mentioned may be much below the tonnage of siliceous ore actually available for mining.

Experiments carried out by Moose Mountain, Limited, indicate that 2·1 tons of ore of type B are required to furnish one ton of concentrates averaging 65 per cent iron. On this basis the ore deposits for each 100 feet of depth would probably yield about 18,500,000 tons of concentrates. The crushing would probably have to be carried to 160 mesh to get a satisfactory separation of magnetite from gangue, but the resulting concentrate would have a high iron content and be of Bessemer grade.

The concentrates necessarily have to be agglomerated in some way for satisfactory handling and for use in the blast furnace, and this Moose Mountain, Limited, has attempted to do by briquetting, the briquettes being burned in gas-fired kilns.

The first of the two analyses given below indicates the chemical composition of the crude ore type B, and the second that of the briquettes produced in 1914, which were made from dust from the cobbing plant or No. 1 mill. Briquettes made from concentrates from ore of type B, would likely be of about the same composition as those already made, except as to the content of phosphorus and of manganese which it is expected would be lower.

	Crude Ore Type B. %	Briquettes shipped, 1914. %
Iron	36·70	63·02
Silica	45·20	6·66
Sulphur	0·019	0·012
Phosphorus	0·057	0·037
Alumina	0·25	1·00
Lime	1·06	1·50
Magnesia	1·59	1·53
Manganese	0·04	0·08
Loss by ignition	0·15	None.

Surface Equipment.—The surface mining equipment consists of two 2,000-cu. ft. compressors, one 150-H.P. double drum hoist, two belt-driven tram hoists, necessary tram cars, tracks, etc., and blacksmith and machine shops.

There are two mills, No. 1 for treating ore of type A, and No. 2 (or Gröndal plant) for fine grinding, magnetic concentration and briquetting, the latter with a rated capacity of 800 tons of crude ore per 24 hours.

Power.—All the equipment is electrically operated by power brought in over the company's own transmission line from the Wanapitei Power Company's plant 35 miles distant, the power being paid for at the power company's switchboard at the rate of $16 per horse power per year based on the peak load.

References:—
W. H. Collins, Geol. Sur. Can., Summary Report, 1912, p. 312.
E. Lindeman, Moose Mountain Iron-Bearing District, Mines Branch, Ottawa, 1914, No. 303.
Fred A. Jordan for Moose Mountain, Limited, Sellwood, Ontario, 1914.

Blairton Mine.

The Blairton iron mine is situated on lots 7 and 8, concession I, in the township of Belmont, Peterborough county. It lies on the shore of the southwest end of Crow lake about 5 miles west of the village of Marmora, and about 3 miles northeast of Blairton station on the Canadian Pacific railway. The distance from Blairton station to Trenton by rail is 34 miles.

The mine was opened up about 1820, and was operated intermittently until 1875. During these years very considerable tonnages of ore were shipped. In 1908 some diamond drilling was done, and in 1910 thirteen holes, with an aggregate footage of 3,600 feet were put down. No exploration or development has been done by the present owners.

The area surrounding the ore-bodies is chiefly occupied by hornblende and chlorite schist and crystalline limestone, in contact with diorite (see

Plate XII.

Open-cut at Blairton m'ne.

Plate XIII.

Pit No.1 at Blairton mine.

map 185a). The general strike of the stratified rocks is about N. 15° W. with a steep dip towards the east.

The ore deposits consist of magnetite, which occurs along the contact of the crystalline limestone and diorite, and is associated with various metamorphic rocks. In some parts of the field the magnetite is found in well-defined layers interstratified with these rocks; in others, finely disseminated throughout the same.

Judging from the magnetometric survey, the ore occurs in two separate areas. On the more southerly of these areas ore has been mined from two open pits, No. 1 and No. 2. The total area of these two pits is 27,500 square feet. The depth of pit No. 1 is 125 feet. By a diamond drill hole the deposit has been proved to a depth of 550 feet.

The other area has been opened up by a large open-cut on the hill-side near Crow lake. Judging from the magnetometric survey (see map 185), the total length of this deposit may be roughly estimated at about 500 feet, its northern end extending about 130 feet under the lake. On the hill-side immediately west of the open-cut several strongly positive magnetic areas, alternating with some strong negative ones, indicate an irregular distribution of the magnetite throughout the rock.

The total area within which ore is likely to occur in this part of the field is roughly estimated at 128,000 square feet, but no doubt a large percentage of this area is occupied by barren rock.

The ore consists of a finely crystalline to massive magnetite, with a gangue of pyroxene and calcite. In the northern ore-body there is a good deal of finely disseminated pyrite.

The ore extracted was won from three open-pits, the Lake pit on an ore-body close to Crow lake, and the Derrick and Morton pits on another ore-body about 1,000 feet farther south. One of the two latter is 200 feet long, and 150 feet wide, and is reported to be 125 feet deep. All the pits are now filled with water.

No record of the total tonnage of ore shipped is now available, but the amount is estimated to have been from 250,000 to 300,000 tons. The average composition of these shipments is not known, but it appears from the piles of waste ore on the property that only an ore of high iron content was shipped. An average sample across the north end of the Lake pit taken by E. Lindeman in 1911 gave the following analysis:—

Iron	50·10	per cent.
Silica	9·88	„ „
Sulphur	1·42	„ „
Phosphorus	0·046	„ „
Alumina	1·73	„ „
Lime	3·52	„ „
Magnesia	1·64	„ „
Titanium dioxide	0·10	„ „

No information as to cost of mining and selling price of the ore shipments is available. The freight rate to the Pittsburgh district, where the ore was shipped, is reported to have been about $4 per ton.

To transport ore from the mine it would be necessary to build a railway spur 6 miles long to the Central Ontario railway. The freight rate to Trenton would probably be about 40 cents per ton.

There is a small amount of mining equipment on the property, but it is all obsolete, and would have to be replaced if mining operations were undertaken.

References:—

R. H. Flaherty, Port Arthur, Ontario, 1904.
E. Lindeman, Mines Branch, Ottawa, Publication No. 184, p. 9.
W. J. McLaughlin for Canada Iron Mines, Limited, Trenton, Ontario, 1914.

Belmont (or Ledyard) Mine.

Owners: The Canadian Furnace Company, Limited, Port Colborne, Ontario.

The Belmont iron mine is situated on lot 19, concession I of Belmont township, County of Peterborough, about 8 miles northwest of Marmora. It is connected with the Central Ontario railway by a branch line known as the Ontario, Belmont and Northern railway. The distance from the mine to Trenton, on Lake Ontario, by rail, is about 39 miles.

This property was operated many years ago, ore being extracted from No. 1 and No. 2 (or Nichol) pits (see maps Nos. 186 and 186a). In 1911 the former had a length of 220 feet, a width varying from 40 to 70 feet, and a depth of from 3 to 20 feet; and the latter (located 100 feet southeast of No. 1) had a length of 55 feet, a width of 40 feet and a depth of 5 to 6 feet. Six diamond drill holes put down in 1906 are said to have proven 200,000 tons of concentrating ore. (W. W. J. Croze.)

In 1911 development work was resumed after a lapse of several years. A 3-compartment shaft, started that year about 15 feet north of No. 1 pit had reached a depth of 260 feet early in 1914, when mining operations were discontinued. Levels were opened from this shaft at depths of 100, 170, and 230 feet. In 1913 the Mines Inspector reported that the ore-body appeared to be widening at depth, and the grade of ore improving.

The character of the iron-bearing formation varies considerably. In some places it consists of almost pure magnetite, in others of a mixture of magnetite and gangue minerals, chiefly pyroxene and chlorite; in other places again the latter minerals prevail almost to the exclusion of the magnetite. Iron pyrites is frequently seen throughout the ore. The ore-body lies along a contact between crystalline limestone and diorite.

An analysis of an average sample taken from the north end of No. 1 pit by E. Lindeman in 1911 is given herewith:—

Iron	51·20	per cent.
Silica	12·10	„ „
Sulphur	0·34	„ „
Phosphorus	0·032	„ „
Lime	4·87	„ „
Magnesia	3·93	„ „
Titanium	0·10	„ „

Since the resumption of mining in 1911 the shipments have aggregated 5,746 short tons, the shipments by years being as follows: 126 tons in 1911, 28 tons in 1912, and 5,592 tons in 1913.

Judging from the magnetometric survey (see maps 186 and 186a) confirmed by a few natural exposures, the area within which the ore is likely to occur may be roughly estimated at 4,300 square feet, but a large percentage of this area is undoubtedly occupied by barren rock.

References:—
Dr. Eugene Haanel, Report of Superintendent of Mines, Ottawa, 1906, p. 5.
W. W. J. Croze for R. H. Flaherty, Port Arthur, Ontario, 1906.
E. T. Corkill, Ontario Bureau of Mines, 1912, p. 158.
E. T. Corkill, Ontario Bureau of Mines, 1913, p. 134.
T. F. Sutherland, Ontario Bureau of Mines, 1914, p. 171.
E. Lindeman, Mines Branch, Ottawa, Publication No. 184, 1913, p. 10.

Bessemer Mines.

Owners: Canada Iron Mines, Limited, Trenton, Ontario.

The Bessemer property includes lots 2, 3, 4 and 5, concession VI, and lot 1, concession VII, in the township of Mayo, county of Hastings. A railway spur, 5 miles long, known as the Bessemer and Barry's Bay railway connects the mine workings with the Central Ontario railway at L'Amable, which is 78 miles north of Trenton, Ontario, where is located a magnetic concentrating plant owned by Canada Iron Mines, Limited.

The Bessemer and other ore deposits in this locality were first exploited by Mr. H. C. Farnum, who in 1902 organized the Mineral Range Iron Mining Company, which assumed the ownership of them. By this company the properties were opened up and shipments of ore were made in 1902, 1903, 1906, and 1907.

In February, 1908, the Canada Iron Furnace Company leased the properties of the Mineral Range Iron Mining Company, and operated them until May 1910, when they surrendered their leases. The mines then lay idle until 1911, when the properties were acquired by the Canada Iron Mines, Limited, who operated them in 1912 and 1913 to supply their concentrating plant at Trenton. Since 1913 the mines have been idle.

The ore deposits occur as isolated lenses of varying extent, associated with a limestone-amphibolite series, along, or adjacent to, a granite contact (see map 191a).

The general strike of the formation is northeast-southwest, with a steep dip towards the southeast, averaging about 60 degrees. The ore consists of fairly coarse-grained magnetite. Its quality varies greatly in different parts of the deposits. In some cases a clean magnetite of high iron content is observed; in others, the magnetite is closely associated with garnet, hornblende, epidote, and calcite, and the ore often appears to pass gradually into such gangue minerals.

The best quality of the ore averages about 54 per cent iron, but considerable cobbing has to be done in order to keep it up to that standard, as a large percentage of the ore does not average more than 40 to 48 per cent iron.

This latter ore was, until 1911, relegated to the waste dumps, or left in the mine. Locally, stringers and patches of iron pyrites are found, but by hand cobbing the ore it was found possible to keep the sulphur down to somewhere near 0·07 per cent. The percentage of phosphorus is very low, averaging from 0·010 to 0·025 per cent.

Since the completion of the concentrating plant at Trenton, the ore is no longer cobbed at the mine, but is shipped as mined.

While the presence of a large number of ore-lenses of different size is known, mining operations have been confined to four (see maps Nos. 191 and 191a), which will be described in order from west to east.

Deposit No. 1, on lot 1, concession VII, was developed as an open-pit, and a small tonnage of ore has been shipped from it. The ore in this pit is badly mixed with gangue minerals, chiefly hornblende. The presence of a number of small ore-lenses adjacent to deposit No. 1, is indicated by the magnetometric survey by E. Lindeman.

Deposit No. 2, is one of a group of deposits on lot 2, concession VI, all of which the magnetometric survey indicates as being very small. It has been developed as an open-cut from which a little ore was extracted. The workings show the magnetite to be intermixed with various gangue minerals.

Deposit No. 3, is located on lot 3, concession VI, and is about 1,300 feet east of No. 2. It consists of two open-pits, which have been opened up on two ore-lenses separated from each other by about 50 feet of gangue rock, through which a small amount of magnetite is disseminated; the smaller pit is 40 feet by 90 feet and 6 feet deep, and the larger is 60 feet by 60 feet and 20 feet deep. About 5,000 tons of ore were shipped from these workings.

From the bottom of the larger pit a drill hole was put down, and it was still in ore at 160 feet when discontinued.

In addition to the two lenses opened up the magnetometric survey indicates, a short distance east and west of these workings, several other deposits, all of which are, however, covered by drift.

PLATE XIV.

No. 4 mine, Bessemer.

PLATE XV.

No. 3 mine, Bessemer.

Plate XVI.

Open-cut, No. 4 mine, Bessemer.

Deposit No. 4, the largest and richest of the Bessemer group, is situated on lots 4 and 5, concession VI. According to the magnetometric survey, the total possible length of this deposit may be estimated at about 1,000 feet, the western end extending 400 feet under Little Mullet lake. The average width of the deposit is roughly estimated to be about 50 feet (see maps 191 and 191a).

This deposit was first worked as an open-pit, and from this a very considerable tonnage was extracted, the pit being carried to a depth of 80 feet. Operations in recent years have been conducted from a 3-compartment shaft started in 1908. The shaft is inclined to the southeast at 65 degrees, and has a depth of 236 feet, and from it levels have been opened at depths of 55 feet, 101 feet, 161 feet, and 236 feet respectively. On the 2nd level the length of the workings in ore is 495 feet, and on the 3rd it is 525 feet. The present workings have proven ore to a greater depth than did the diamond drill holes put down a few years ago.

Judging from the results of the magnetometric surveys, confirmed by the distribution of a few natural exposures, we may estimate the total ore area of the seven largest deposits to be about 83,000 square feet, of which 50,000 are attributed to No. 4 deposit.

This estimate does not, however, pretend to be more than a very rough approximation; besides, a considerable portion of this area contains, no doubt, ore which has too low iron content to be suitable for economic iron smelting without previous concentration.

In order to ascertain the suitability of the ore for magnetic concentration, tests have been made at the Ore Dressing laboratory at Ottawa on a shipment of 1·5 tons of discarded ore from No. 4 mine. The sample was crushed down until 50 per cent of the ore passed through 200 mesh, and separated by the Gröndal wet process. The result of the test is shown in the following table:—

Analyses of Crude Ore, Concentrates, and Tailings.

	Crude ore.	Tails.	Concentrates.
Iron	36·50%	4·5%	67·4%
Insoluble matter	35·37	...	5·87
Phosphorus	0·026	...	0·007
Sulphur	0·314	...	0·185
Lime	5·68	...	......
Magnesia	0·030	...	......

It will be seen from the above figures that 1·96 tons of this material is required to make 1 ton of concentrate with an iron content of 67·4 per cent. The percentage of iron in the crude ore saved in the concentrate is 94 per cent, while about 6 per cent of the iron content of the ore is lost in the tailings. The phosphorus, although below Bessemer limit, in the crude ore, has been depressed to a point that should make the concentrate very valuable for the production of special low phosphorus iron.

All ore shipped from the Bessemer property prior to the opening of the concentrator at Trenton was hand-sorted. Since then the ore is shipped as mined.

The shipments to the end of 1914 are reported as follows:—

From No. 1 deposit....	700	gross tons (hand sorted).
„ „ 2 „	1,500	„ „ „ „
„ „ 3 „	5,000	„ „ „ „
„ „ 4 „	92,413	„ „ („ „ and crude).
Total................	99,613	

The two following analyses were furnished by the Midland Blast Furnace, No. 1 representing ore received from Bessemer mines in 1907, and No. 2 a 25-car shipment received in 1908.

	No. 1.		No. 2.	
Iron....................	54·29	per cent.	54·00	per cent.
Silica..................	9·84	„ „	......	
Sulphur................	0·062	„ „	0·075	„
Phosphorus.............	0·019	„ „	0·022	„
Alumina................	2·02	„ „		
Lime....................	6·86	„ „		
Magnesia...............	1·35	„ „		
Manganese..............	0·38	„ „		

Two average samples of discarded ore from No. 4 mine gave the following analyses:—

	No. 1.		No. 2.	
Metallic iron, Fe.........	47·70	per cent.	42·50	per cent.
Lime....................	8·75	„ „	13·05	„ „
Magnesia...............	4·07	„ „	2·80	„ „
Alumina................	2·34	„ „	2·79	„ „
Silica..................	15·30	„ „	19·20	„ „
Phosphorus.............	0·004	„ „	0·30	„ „
Sulphur................	0·63	„ „	0·30	„ „

The mining plant is operated by steam, two 150-H.P. boilers being installed for this purpose. The mining equipment includes an air compressor (with a capacity of 1,400 cubic feet of free air per minute), one 6-K Gates crusher and the necessary hoists, drills, etc.

Camps and cottages for accommodating the employees are maintained by the operating company.

Childs property.

References:—
Ontario Bureau of Mines, Mines Inspector's Reports. 1902-1912 inclusive.
Geo. C. Mackenzie, Ontario Bureau of Mines, 1908, p. 221.
E. Lindeman, Mines Branch, Ottawa, Publication No. 184, p. 16.
W. J. McLaughlin for Canada Iron Mines, Limited, Trenton, Ontario, 1914.

Childs Mine.

Owners: Canada Iron Mines, Limited, Trenton, Ontario.

The Childs mine is located on the south halves of lots 11 and 12, concession IX, in the township of Mayo, county of Hastings, about 3 miles east of the Bessemer mine, with which it is connected by the Bessemer and Barry's Bay railway.

The property was first exploited by Mr. H. C. Farnum, and later by the Mineral Range Iron Mining Company. Very little work was done on it prior to 1913, when the present owners made a systematic exploration of it, and commenced mining operations. Since 1913 the mine has not been in operation.

The ore deposits are found in mica schist, and lime-amphibolite rocks near their contact with granite and other igneous rocks (see maps 192 and 192a). The magnetic survey indicates that this property is likely to contain ore bodies of considerable size.

The ore is a coarsely crystalline magnetite usually intermixed with a gangue of garnet, epidote, calcite and other minerals.

An average sample taken across the ore-body by E. Lindeman gave the following analysis:—

Iron	42·00	per cent.
Silica	12·53	" "
Phosphorus	0·066	" "
Sulphur	0·160	" "
Lime	7·75	" "
Magnesia	2·00	" "
Titanium	0·10	" "

In 1913, four working faces were stripped and opened on that portion of the deposit lying above swamp level, and ore was broken in open-cuts. It is proposed to operate the deposit as an open-pit to the depth permissible by condition of the walls, and after that to introduce a milling system of mining.

The mining equipment consists of two 75-H.P. boilers, one 5-K Gates crusher, crusher engine, hoist, locomotive, mine cars and steam drills.

A small camp is maintained for the accommodation of the employees.

References:—
Mines Inspector's Reports, Annual Reports, Ontario Bureau of Mines, 1902-1915 inclusive.
E. Lindeman, Mines Branch, Ottawa, Publication No. 184, p. 19.
W. J. McLaughlin for Canada Iron Mines, Limited, 1914.

Coehill Mine.

Owners: Canada Iron Mines, Limited, Trenton, Ontario.

This mine is situated on lots 15 and 16, concession VIII, in the township of Wollaston, county of Hastings, and it is connected by a branch line 7 miles long, with the Central Ontario railway at Ormsby junction. The distance by rail from the mine to Trenton is 73 miles.

The mine was opened in the early eighties, and shipments were made from 1884 to 1887 inclusive. It is reported that during this time the quantity of ore mined was between 80,000 and 100,000 tons, about one-third of which was left in stock piles. The high sulphur content of the ore prevented a market being found for it.

Small shipments were made from ore in stock in 1900 and 1909. In 1910 six diamond drill holes, averaging 450 feet in depth were put down. The property is now owned by Canada Iron Mines, Limited, but it has not as yet been operated by them.

The main ore-body is well exposed on the hill north of the railway track by two open-pits. The general trend of the formation is northeast-southwest, with a dip of about 50 degrees towards the southeast. The deposit seems to form part of a limestone-amphibolite series, locally enriched in iron by the intrusion of syenite, which cuts the series in the most intricate manner. The ore consists of a fine-grained magnetite, associated with hornblende, pyroxene and calcite. It has a streaked or stratified appearance parallel to the strike, which is due to the variation in the relative amount of the constituent minerals present. Some streaks are very rich in magnetite, while others are composed of pyroxene and hornblende. The average sulphur content of the ore is high, a considerable amount of pyrite and pyrrhotite being disseminated throughout the ore.

In addition to the main ore-body the existence of several others to the north is indicated by Lindeman's magnetometric survey (see maps 190 and 190a).

The mine was operated as an open-cut at first, and later from three shafts. No. 1, shaft, reported to be 95 feet deep, was sunk on a deposit which the magnetometric survey indicates to be of very small extent (see map 190). No. 2 and No. 3 shafts at the main ore-body are reported to have depths of 130 and 100 feet respectively. All the old workings are now filled with water.

The total shipments from the property between 1880 and 1914 are reported to have been 54,783 long tons. No analyses of the ore shipped are available, but an average sample taken across the ore-body by E. Lindeman gave the following analysis:—

Iron	47·30	per cent.
Insoluble	30·90	" "
Sulphur	2·21	" "
Phosphorus	0·018	" "

PLATE XVIII.

Shaft No. 3, Coehill mine.

The mining equipment installed in the early days of the mine has not been dismantled, but it would have to be replaced by up-to-date equipment if the mine were operated.

References:—
E. Lindeman, Mines Branch, Ottawa, Publication No. 184, p. 14.
W. J. McLaughlin for Canada Iron Mines, Limited, Trenton, Ontario, 1914.

QUEBEC.

Bristol Mine.

The Bristol mine is situated on the north half of lots 21 and 22, range II, in the township of Bristol, county of Pontiac, about 4·8 miles northwest of Chats falls on the Ottawa river. A standard gauge railway 4¼ miles long, connects the mine with Wyman station on the Ottawa-Waltham branch of the Canadian Pacific railway.

The first work dates back to the winter of 1872-3, when the north halves of lots 21 and 22 were leased to an American syndicate and some openings made. No ore was shipped and after some years the lease was allowed to expire. In 1883 the properties were leased to another syndicate, and mining operations started in the autumn of 1884. These operations, however, were confined to lot 21, and chiefly to shaft No. 1. A compressor and hoisting plant were installed, and necessary shops erected. As the ore contained considerable iron pyrites, two roasting kilns with six gas producers were built, and the ore was crushed and roasted before shipment was made. Operations were carried on, with several interruptions, until 1894, when the mine was closed down. Since that time no attempt has been made to re-open it, and at present all the workings are filled with water.

Geologically, the area presents a series of schists and gneisses, associated with crystalline limestone, all of which are cut by granites. The strike of the bedded rocks varies from N. 70° W. to N. 42° W., with a dip towards the north varying from 35° to 89°.

A magnetometric survey made by E. Lindeman, in 1909, indicates the existence of three areas in which the vertical magnetic attraction is very strong (50° or more). These areas are respectively 25,000, 60,000, and 90,000 square feet, and in addition there are other areas of less importance. (see map 441).

During 1910, Ennis and Company of Philadelphia made several trenches in the areas of strong magnetic attraction, showing that the formation is not uniformly made up of magnetite, but that the ore-bodies constitute a series of lenticular masses or bands of magnetite, with a certain percentage of hematite in places; none of the lenses show a width of clean ore greater than 40 feet. The magnetite is generally interbanded with mica and hornblende schist, in which it is often abundantly disseminated. The whole series of these foliated rocks is cut by intrusions of granite.

Though the ore deposit cannot be said to cover the same surface area as the lines of strong magnetic attraction, it is possible that in these areas the magnetite bands are so frequent and the inclosing rocks so impregnated with disseminated magnetite that the whole deposit could be worked. In such a case special treatment will be required both for increasing the percentage of iron and for decreasing the percentage of sulphur. The property is considered worthy of further exploration in the form of diamond drilling.

At present the development work is not sufficient to make any estimate of the reserves of ore.

The following analyses represent average samples of 100 pounds taken from two of the largest ore-piles at the mine.

	1.	2.
Metallic iron	58·180 per cent.	53·740 per cent.
Sulphur	1·480 " "	2·920 " "
Phosphorus	0·008 " "	0·007 " "

In 1909, in addition to the magnetometric survey of the property, magnetic concentration experiments on Bristol mine ore were carried on by Mr. G. C. Mackenzie, of the Mines Branch, Ottawa. The results from this work showed that a concentrate high in iron, and low in phosphorus, could be obtained. The objectionably high sulphur content of the concentrates would be reduced by the nodulizing or sintering processes required to put the concentrates in suitable form for blast furnace use.

References:—
Cirkel. Report on the Iron Ore Deposits along the Ottawa and Gatineau rivers, Mines Branch No. 23, pp. 75–90.
Lindeman and Mackenzie. Mines Branch, Iron Ore Deposits of Bristol Mine, No. 67.
Dulieux. Report on Mining Operations in Quebec for 1912, pp. 107–114.

NEW BRUNSWICK.

Bathurst Mines.

Owners: Canada Iron Corporation, Limited, Montreal, Que., (in liquidation).

The Bathurst iron mines are situated in Gloucester county, New Brunswick, about 21 miles southwest of the town of Bathurst, in the vicinity of Austin brook, a small tributary of the Nipisiguit river. In November, 1907, these deposits were acquired by the above company, and mining operations were started after a branch line had been built connecting the property with the Intercolonial railway at Blacks cut about 4 miles south of Bathurst, the distance from the mine to Blacks cut being about 17 miles. Docks for the transhipment of the ore have been built at Newcastle, the railway haul from the mine to the docks being 57 miles. The ore pocket has a capacity of 13,000 tons, and the dock has a loading capacity of 3,000 tons per hour. Ocean vessels drawing 21 feet may dock. In 1911 a concentrating plant to treat the ore before shipment by crushing,

PLATE XIX.

Bristol Mine, Pontiac county, Que., 1894.

screening, and jigging was erected at the mine. The results obtained, however, were not satisfactory. Mining operations were discontinued in 1913 when the company went into liquidation.

The following shipments have been made:—

1910	4,764	gross tons.
1911	27,786	"
1912	63,857	"
1913	76,665	"
1914	4,400	"
1915	3,288	"
Total	180,760	"

Ore Reserves.—The estimate by E. Lindeman is based on information from his magnetometric surveys, surface outcrops and diamond drill holes. The total horizontal area of ore, in all the deposits is placed at 314,000 square feet. The crude ore is assumed to have specific gravity of 3·8, the quantity of ore would be approximately *3,720,000* tons for every 100 feet of depth. Assuming a vertical depth of 500 feet for all the deposits, which is approximately the vertical depth to which deposit No. 1, of group No. 1 has been proved, the probable ore amounts to *18,600,000* tons. This ore is too low grade to be marketed in its natural state. It would be necessary either to concentrate it or to follow a method of selective mining, and stope ore of a certain grade only.

A report submitted by the Canada Iron Corporation says No. 1 deposit has an estimated reserve of *3,800,000* tons, and No. III, assuming a length of 2,000 feet, width 60 feet and depth 350 feet, from magnetometric survey and bore holes, an estimated reserve of *3,360,000* tons.

Composition of the Ore.—The following analyses show the average composition of the ore:—

	No. 1.	No. 2.	No. 3.
Iron	43·7	46·6	47·5 per cent.
Insoluble	26·3	24·7	22·7 " "
Phosphorus	0·64	1·04	0·65 " "
Sulphur	0·05	0·02	0·05 " "
Manganese	1·00	1·8	1·2 " "

1. Average sample...............Group I.
2. " " Deposit No. 2, " II.
3. " " .... " III.

Ore-Bodies.—The ore occurs as elongated lenses in a schistose quartz-porphyry, and consists of a very fine-grained siliceous magnetite, mixed with a considerable amount of hematite. It is often interbanded with jasper and a green slaty gangue material, which give the deposits a conspicuous bedded structure. Veins of quartz are of common occurrence, and generally follow the bedding planes of ore. The metallic iron content of the various layers varies, therefore, considerably, ranging from 59 down to 35 per cent, the average being about 46·18 to 48·1 per cent.

The average phosphorus content is about 0·8 per cent with manganese 2·7 per cent locally and sulphur ranging from 0·03 to 0·1 per cent; but locally the sulphur content is much higher. This is especially the case near the contact of the ore with the country rock, where layers of iron pyrites varying in thickness from a fraction of an inch up to several feet, often occur.

The ore-bodies lie in three main groups, which for reference are numbered I, II, and III (see map No. 106).

Group I is situated west of Austin brook, and consists of one ore-body, the total length of which is about 2,150 feet. The northern end of this deposit is well exposed, rising abruptly to a height of 75 feet above Austin brook. Farther south it is covered by gravel of considerable depth, but it outcrops again about 100 feet from the Nipisiguit river, where its contact with the schistose porphyry is well exposed. Diamond drilling showed the deposit to dip at an angle of about 60° to the west, and close to surface to have thicknesses of 106 and 8 feet at the north and south ends, respectively, and a thickness of 60 feet near the centre. A deep hole near the centre showed the ore-body to have a thickness of 64 feet at a depth of about 500 feet.

Group II lies east of Austin brook, and is made up of several ore-lenses, which for reference are numbered 1, 2, 3 and 4.

No. 1 deposit outcrops on the hill slope towards the Nipisiguit river, and is, according to the magnetic survey, of inconsiderable extent. Deposit No. 2, on the eastern bank of Austin brook, is probably 250 feet long, and has widths of 19 and 42 feet at the north and south ends, respectively. No. 3, is almost completely covered by humus, but is probably 350 feet long. No. 4 has a length of 400 feet, and a maximum width, at the south end, of 30 feet.

Between Groups II and III, 1,600 feet apart, the magnetometric survey gives no indication of ore deposits (see map No. 107). The deposits comprising Group III are almost entirely overlain by drift. The iron-bearing area has a length of about 4,400 feet, and probably contains a great number of ore-lenses which vary considerably in size. On the chief deposit two drill holes, Nos. 5 and 6, were put down, No. 5 cutting ore similar to that in Group I to a depth of 327 feet, and No. 6 revealing only lean ore with bands of jasper. This deposit has an average width of 100 feet and is probably 830 feet long. About 150 feet north of this deposit another ore-lense is situated, on which drill hole No. 7, cutting ore similar to that in the other deposits, was sunk. This ore-body has a total length of about

PLATE XX.

Bathurst mine, Austin Brook, N.B.

Open-cut on No. 1 deposit, Austin Brook, N.B.

400 feet, with a maximum width at the surface of about 90 feet. Besides these two ore-bodies the magnetometric survey indicates the presence of a number of others which are all covered by humus, and on which no diamond drilling has been done.

In 1911, the ore dressing plant of the Mines Branch, Ottawa, made experiments in magnetic concentration on a 15-ton lot of Bathurst Mine ore. There was a very considerable loss of iron in the tailings due to part of the crude ore being hematite.

References:—
E. Lindeman, Mines Branch, Ottawa, No. 20.
G. C. Mackenzie, Mines Branch Summary Report, 1911, p. 61.
Information supplied by Canada Iron Corporation, Ltd., Montreal, Que.
G. A. Young, Geol. Sur. Can., Memoir No. 18 E.

NOVA SCOTIA.

Wheelock and Martin Mines.

North Range, Torbrook area, Annapolis county.

Owners: Canada Iron Corporation, Limited, Montreal, Que., (in liquidation).

In 1908 the Annapolis Iron Company became merged in the Canada Iron Corporation, the Wheelock mine becoming No. 1 and the Martin mine No. 2 mine of that corporation. During the two following years the work was chiefly confined to the development of No. 2 mine and to the building of the railway, connecting the mines with the Halifax and South Western railway at Nictaux. A shipping dock at Port Wade 55 miles by rail from the mines was also erected. The main ore-pockets at the dock have a capacity of 7,000 (long) tons. At the head of the pier a loading-pocket of 400 (long) tons capacity has been built and the ore is transported from the main pocket to the loading pocket by a bucket conveyer 1,000 feet long.

The first shipment of ore from Port Wade was made in 1910 when three cargoes of 4389, 5402, and 6499 tons were shipped to Chester, Pa., Ardrossan, Scotland, and Middlesborough, England, respectively. The average iron content of the three cargoes was about 48 per cent.

During 1910 and 1911 mining operations were continued, but, with the exception of the three abovementioned cargoes, no ore was shipped, it being found necessary to concentrate the ore before further shipment could be made. Subsequently a concentrating plant was erected at Nictaux where the large stock piles of ore which had accumulated at the mines were treated, and, during 1912 and 1913, eight cargoes of concentrates running from 50-52% iron were shipped as follows: four (23,073 tons) to Ardrossan, Scotland; two (12,429 tons) to Rotterdam, Holland; one (4,358 tons) to Middlesborough, England; one (5,676 tons) to Philadelphia. The total shipments to the end of 1913 amounted to 61,853 tons. Mining operations ceased, however, in August 1913, and since then the properties have been lying idle.

The Wheelock or No. 1 Mine.

The Wheelock, or No. 1 Mine, is sunk on the "Shell" bed on the Fletcher Wheelock farm. It has been the chief producer on this bed, though there were a number of other openings from which ore has been shipped. It was operated from 1905 to 1908, the ore being shipped to Londonderry. In 1907 the shaft had reached a depth of 180 feet with levels at 80 and 150 feet. The 80-foot level had at that time been driven 445 feet east and 370 feet west; the 150-foot level, 280 feet east and 330 feet west.

The iron ore bed averages 7 feet in thickness, increasing to 18 feet on rolls and thinning out completely in two places where the bed takes a sudden turn. The following is the average analysis of the ore shipped:—

Iron	43·6	per cent.
Insoluble	17·4	„
Phosphorus	1·1	„

The highest average of analysis of shipments for any one month was for May, 1907:—

Iron	46·76	per cent.
Insoluble	15·19	„

The Martin, or No. 2 Mine.

This mine has been opened on the Hematite, or Leckie bed near the east boundary of the Edward Martin farm. It is situated about 2,000 feet southwest of No. 1 or Wheelock mine. The shaft is down 500 feet, with levels running off on both sides. On the west side of the shaft, the levels all measure about 300 feet in length, while on the east side the longest levels, No. 2 and No. 3, are 900 feet each. Most of the ore has been stoped out on the Hematite vein west of the shaft. East of the shaft to the depth of the 500-foot level there is approximately 115,000 tons in the stopes, probably all of which must be concentrated. The thickness of the ore varies from 3 feet 9 inches to 6 feet 6 inches, with an average of about 5 feet. The total quantity of ore raised up to August 1913, when mining operations ceased, was *102,100 tons.*

From No. 2, No. 3, and No. 5 levels cross-cuts have been driven to the Shell bed, which at this point is 100 feet to the southeast. From one of the cross-cuts a drift 850 feet long has been run on this bed, and a small quantity of ore has been mined. This level has been timbered, and stoping has been commenced.

PLATE XXIII.

No. 2 mine, Canada Iron Corporation, Torbrook, N.S.

The *Shell* vein has been intersected by cross-cuts on four levels from the Martin shaft and the reserve of this ore is placed at 250,000 tons.

Experiments in magnetic concentration of ores from the Shell bed and the Leckie bed made at the ore dressing plant of the Mines Branch gave unsatisfactory results, owing to such a large percentage of the crude ore being hematite.

References:—

J. E. Woodman, Mines Branch, Ottawa, No. 20.
H. Fréchette, Mines Branch, Ottawa, No. 110.
G. C. Mackenzie, Mines Branch, Summary Report, 1911, pp. 64-71.
Information supplied by Canada Iron Corporation, Limited, Montreal, Que.
C. S. Parsons, Trans. Can. Min. Inst., Vol. XVI, p. 608.

SUPPLEMENT.

NEWFOUNDLAND.

Wabana Iron Mines.

Owners: Dominion Steel Corporation, Limited, Sydney, Cape Breton, N.S.; Nova Scotia Steel and Coal Company, Limited, New Glasgow, N.S.

On Bell island in Conception bay, Newfoundland, and in submarine areas adjacent thereto are situated iron ore beds the workings on which are known as Wabana Iron Mines.

Ore Deposits.—The Wabana ore occurs in five principal beds through the upper 1,000 feet of a series of unmetamorphosed Ordovician sandstones and shales. The ore-beds outcrop for a distance of about 3 miles along the northern shore of Bell island and dip to the northwest beneath the waters of Conception bay at an angle of 8°. Only three of the ore-beds are considered of economic interest; these are the "Dominion" or "Lower," the "Scotia," and the Little Upper ore-beds.

The Little Upper bed has an area on Bell island of 70 acres. It varies in workable thickness from 5 to 8 feet, and averages about 6 feet. The ore varies in quality from 56 per cent iron in the upper portion, to 51 per cent iron in the lower section of the bed, and the silica content varies from 6 to 10 per cent.

The "Scotia" bed lies 50 feet below the Little Upper bed. It varies in thickness from 7 to 9 feet and contains 53 to 56 per cent iron, 7 to 9 per cent silica, and 0·80 to 0·90 per cent phosphorus.

The Lower or "Dominion" bed is situated 243 feet below the "Scotia" bed. At the surface it varies in thickness from 8 feet at the eastern to 14 feet at the western outcrops. In the underground workings the thickness ranges generally from 12 to 20 feet, though at one point in the submarine workings a thickness of 33 feet has been proven. Through the entire explored area this bed has an average workable thickness of 16 feet. To the end of 1913 the ore recovered from the open-cut workings on this bed had amounted to 4,347,150 gross tons.

The iron content of the ore mined from the land areas of the Dominion bed varies from 50·50 to 53·0 per cent, silica from 10·5 to 14·0 per cent, and phosphorus from 0·70 to 0·85 per cent. At distances of 4,000 to 8,000 feet from shore the ore has been proven by a few drill holes to be thicker than on the land areas and to be of slightly better grade.

Physical Characteristics of the Ore.—The ore from all the Wabana beds has the reddish-brown colour typical of amorphous hematite, a fresh fracture presenting a reddish-grey colour with submetallic lustre. When shattered the ore breaks readily into parallelopiped-shaped blocks, these being seldom larger than 8 inches square or smaller than $1\frac{1}{4}$ inches square. The specific gravity is high and the ore in place will average about 9 cubic feet to the ton.

The ore is composed of two principal iron-bearing minerals, hematite and chamosite, while a third, siderite, becomes locally abundant. Quartz is present in some quantity in small fragments scattered throughout the ore.

Chemical Analyses.—From the iron and phosphorus contents of the ore-beds mentioned above it will have been noted that the Wabana ore is all of *non-bessemer grade.* The following is a typical analysis (Cantley 1911) of ore from the Scotia beds:—

Iron	53·86 per cent.
Silica	9·48 " "
Sulphur	0·018 " "
Phosphorus	0·850 " "
Alumina	3·55 " "
Lime	1·81 " "
Magnesia	0·84 " "
Manganese	0·65 " "
Loss on ignition	4·32 " "

The average analysis of 220,000 tons shipped by the Nova Scotia Steel and Coal Company to Philadelphia in 1910, and the average analysis of the aggregate shipments by the same company in the years 1910, 1911, and 1912, are given herewith:—

	1910 shipments to Philadelphia.	Total shipments 1910, 1911, 1912.
Iron	53·71 per cent.	51·88 per cent.
Silica	......	9·56 " "
Phosphorus	0·868 " "	.....
Moisture	2·31 " "	.....

Ore Shipments.—The total ore shipments from Wabana mines from 1909 to 1915, inclusive, amounted to 7,140,046 gross tons. From the commencement of mining operations in 1895 to 1909 one of the operating companies (Nova Scotia Steel and Coal Company) had shipped 3,405,588 gross tons. The aggregate shipments to the close of 1915 were in excess of 13,000,000 gross tons.

From 1909 to 1915 inclusive the amount of Wabana ore shipped to blast furnaces in Nova Scotia was 4,806,277 gross tons (5,383,030 short tons), and this amount represents almost the entire consumption of the Nova Scotia furnaces for the period mentioned.

Ore Resources.—Any estimation of the total amount of ore present in the Wabana deposits depends largely on an interpretation of the structure of the ore-strata and hence must be largely hypothetical. The only known data are the lengths of the outcrops on Bell island, the section given by the submarine slopes with a length of about 10,000 feet, and the thickness of the beds shown in the underground workings. From these data Elwin E. Ellis has estimated the reserve of ore of present commercial grade as 3,250,000,000 tons, allowing for workings 5 miles long; Edwin C. Eckel in his book on "Iron Ores," p. 378, gives the reserve of economically available ore as 2,600,000,000 tons. Both Ellis and Eckel, and other engineers as well, believe that the tonnage of ore in the beds may far exceed the figures given above but that the reserve tonnage will in all likelihood be determined by working conditions and cost rather than by the exhausting of the ore-beds.

The Wabana ore-beds are of a higher grade in iron than most other sedimentary ores; the total tonnage present makes up one of the very largest, and by far the most compact ore reserves in the world; and in spite of the fact that the bulk of the tonnage is submarine the ore can be placed in any Atlantic port of America or Europe at a cost far lower per unit of iron than any competitive ore. In summing up the extent and control of the world's iron ore reserves Eckel says (p. 425) "the 4,000,000,000 tons of Newfoundland ore may be the most important single factor in our next stage of progress, for, as soon as an ore-holding reaches a size to justify changes in metallurgical practice or plant location, its ores acquire a technical and moral value far above that which they would have if merely sold on a competitive basis in an open market."

Ownership of Ore Deposits.—The Wabana ore deposits are owned by two companies, the Dominion Steel Corporation, and the Nova Scotia Steel and Coal Company, both Canadian companies, with their blast furnaces, and steel mills in Canada. The Dominion Steel Corporation owns the Dominion bed on Bell island, and all the ore-beds in a submarine area of 3½ square miles adjacent to the north shore of the island, and in a second submarine area (of 2½ square miles area), farther from Bell island. The Nova Scotia Steel and Coal Company own the portions of the "Scotia" and Little Upper beds on Bell island, and all the ore in submarine tracts with an area of 82½ square miles, the most easily accessible of the latter being about 4,000 feet from Bell island, and now being operated by a slope driven through the Dominion Steel Corporation's larger submarine area.

Mining Operations of the Dominion Steel Corporation.

The mining operations of the Dominion Steel Corporation have as yet been restricted to their land areas. Sevèral quarries and slopes have been operated. The underground mining is carried on under a modified system of room and pillar, rooms 25 feet wide being driven from the slopes at 50-foot intervals. The output of ore can be maintained at upwards of

5,000 tons per day, and when submarine mining is commenced a like tonnage can be hoisted through the slopes already driven through this ground by the Nova Scotia Steel and Coal Company.

The ore is crushed to pass a 5-inch ring and is cobbed on picking belts before going to stock piles or ore bins. The haulage from stock piles or ore bins to the shipping pier is done by an endless cable system capable of handling over 5,000 tons per day. The pockets for storage of ore are located close to the pier and have a capacity of 23,000 tons. The bucket conveyers for conveying the ore from the storage pockets to the pier handle from 2,200 to 2,500 tons per hour. Cargoes of 10,000 tons have been loaded in 4½ hours. The pier is located on the south side of Bell island where good protection is afforded and where there is sufficient depth of water to permit the largest of ocean freighters to safely tie up.

In 1914, the Dominion Steel Corporation estimated the tonnage of ore economically available in their land areas as 21,500,000 tons, and in their submarine areas as 120,000,000 tons.

Mining Operations of the Nova Scotia Steel and Coal Company.

The Nova Scotia Steel and Coal Company have extracted all the ore in the portion of the "Scotia" bed on Bell island except the pillars, which can be broken down when the ore of the Little Upper Bed, 50 feet above, is all mined. Work on the latter was commenced in 1914. The submarine areas were tapped in 1908 and by the close of 1911 the main slope had been extended 3,600 feet into this territory. The submarine areas were, as rapidly as possible, put in shape for producing tonnage, and since 1911, all ore shipped has come from them.

From the main slope (with a section 8 feet by 16 feet), which followed the "Scotia" bed, drill holes were put down to test the "Dominion" bed in the submarine areas of the Nova Scotia Steel and Coal Company. As the drilling proved the latter to be thicker and of better grade than in the land areas the dip of the slope was increased from 8° to 30° so that the slope would cut the "Dominion" bed. The latter bed was reached by this slope in December 1910 and is reported to have proved up to expectations.

A commencement has also been made on sinking two deep slopes from points south of the outcrop of the "Dominion" bed on Bell island. These will be driven below the lowest ore-beds of the Dominion Steel Corporation's larger submarine area to reach the Nova Scotia Steel and Coal Company's submarine area already penetrated by the upper slope.

In the underground workings the room and pillar system, with modifications, is used in extracting the ore, and shovelling machines are used for loading the ore cars.

The hoisting is done in 20-ton cars and the equipment is designed to handle 3,000 tons per day. During 1913 and 1914 the actual daily average hoist approximated 2,000 tons per day. After reaching the surface the ore passes over picking belts both before and after being crushed.

A double track tramway operated by an endless cable is employed to move the ore from the deckhead or stock piles to the storage bins situated close to the shipping pier. The capacity of the haulage system is 3,000 tons per day.

The ore pocket, which occupies a ravine in the rocky coastline holds 40,000 tons and this, with the pockets on the pier, gives a storage capacity of 60,000 to 70,000 tons. The ore is conveyed from the storage pocket to the pier by an endless bucket conveyer. Improvements in the haulage and loading facilities made in recent years have made possible the loading of boats at a rate exceeding 5,000 tons per hour.

Practically all pumping, haulage, crushing, ventilation, etc., are done by electric power. The power is generated at a power house erected close to the shipping pier where it may easily be supplied with coal brought from the company's properties in Nova Scotia.

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R. E. Chambers, Journal Canadian Mining Institute, Vol. XII, 1909, p. 139.
Thomas Cantley, Journal Canadian Mining Institute, Vol. XIV, 1911, p. 274.
Edwin C. Eckel, Iron Ores. Their Occurrence, Valuation and Control, 1914, pp. 273, 378, 386, 425.
A. O. Hayes, Wabana Iron Ore of Newfoundland, Geol. Sur. Can., Memoir No. 78, 1915.
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CANADA
DEPARTMENT OF MINES
HON. ALBERT SÉVIGNY, ACTING MINISTER; R. G. MCCONNEL, DEPUTY MINISTER.

MINES BRANCH
EUGENE HAANEL, PH.D., DIRECTOR.

Iron Ore Occurrences in Canada

IN TWO VOLUMES

COMPILED BY
E. Lindeman, M.E.
and
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Introductory
BY
A. H. A. Robinson, B.A.Sc.

VOL. II

DESCRIPTIONS OF IRON ORE OCCURRENCES

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ILLUSTRATIONS.

Maps.

APPENDIX: consisting of maps *enclosed in special case*, as follows:—

No. 342a. Geological map, Atikokan iron-bearing district, claims 403R, 404R, 138X, 139X, and 140X, Rainy River district, Ontario.

" 343. Magnetometric map, Atikokan iron-bearing district, Mile Post No. 140, C. N. Railway, Rainy River district, Ontario.

" 343a. Geological map, Atikokan iron-bearing district, Mile Post No. 140, C. N. Railway, Rainy River district, Ontario.

" 405. Magnetometric map, Orton mine, Hastings Co., Ontario.

" 409. Magnetometric map, Kaministikwia, Thunder Bay district, Ontario.

" 410. Geological map, Kaministikwia, Thunder Bay district, Ontario.

" 416. Magnetometric map, Matawin iron range, claims 215W to 223W, (inc.) Thunder Bay district, Ontario.

" 438. Magnetometric map, Western Steel iron claim at Sechart, Vancouver island, B.C.

" 439. Magnetometric map, Baldwin mine, Hull township, Quebec

" 441. Magnetometric map, Wilbur mine, Lanark Co., Ontario.

" 442. Magnetometric map, Iron Crown claim at Nimpkish river, Vancouver island, B.C.

" 444. Magnetometric map, Northeast Arm iron range, Lots W.D. 341, W.D. 342, W.D. 343, and W.D. 351, Lake Timagami, Nipissing district, Ontario.

" 446. Magnetometric map, Radenhurst and Caldwell mines, Lanark Co., Ontario.

VOL. II.

DESCRIPTIONS OF IRON ORE OCCURRENCES.

IRON ORE OCCURRENCES IN CANADA.

VOL. II.

DESCRIPTIONS OF IRON ORE OCCURRENCES.

YUKON TERRITORY.

LIST OF OCCURRENCES INVESTIGATED.—

- Wind and Bonnet Plume Rivers
- Rackla River
- Hutshi River
  - Mack's Copper Claims

The existence of iron ore at the headwaters of the *Wind and Bonnet Plume rivers* has been known for some years, but no data are available regarding these deposits. The drift from these ore bodies is wide-spread in the basins of both the *Peel and Stewart rivers:* being found all along the tributaries of the latter, as far as the *mouth of the McQuesten*. The pebbles, wherever found, show an exceedingly fine-grained, very compact hematite; in cases containing thin bands of red jaspilyte. Small boulders showing bands of hematite, four or five inches thick, have been found near the forks of *Rackla river*.

Reference:—
J. Keele, Geological Survey of Canada, 1904, Vol. XVI, p. 22 C.

About 15 miles southwest of Montague, on the Whitehorse-Dawson road, and within 4 miles of *Hutshi river*, on "Mack's Copper" claims, there is an ore-body consisting chiefly of magnetite, with hematite in minor quantities; both more or less impregnated with copper minerals. The main mass of mineral is in the form of a small hill of almost solid iron ore, about 200 feet wide, and from 300 to 400 feet long.

Reference:—
D. D. Cairnes, Geological Survey, Can., Memoir No. 5, p. 55.

BRITISH COLUMBIA.

LIST OF OCCURRENCES INVESTIGATED.—

DESCRIPTIONS OF OCCURRENCES INVESTIGATED IN BRITISH COLUMBIA.

I.

VANCOUVER, AND ADJACENT ISLANDS.

Victoria Mining Division.

COWICHAN LAKE.

A body of hematite is reported to exist a few miles up *Nixon creek*, which flows into Cowichan lake from the southwest. No authentic data are available.

GORDON RIVER.

The Gordon river flows from the north into Port Renfrew, or Port San Juan, about 60 miles northwest from Victoria. *The Baden Powell and Little Bobs mineral claims* are situated up the Gordon valley, about 7 miles from Port San Juan. An outcrop of magnetite occurs on the flank of a ridge, along which it can be traced for 350 feet. In several places on the ridge a sharp contact between the ore and diorite was observed. About 90 feet below this contact a tunnel 114 feet long had been run directly into the hill, showing magnetite along its whole length, with the exception of a diorite dike 8 feet wide, which occurs about 30 feet in from the portal.

An average sample of the ore taken along the tunnel gave the following analysis:—

Insoluble matter	8·88	per cent.
Iron	58·30	"
Sulphur	2·75	"
Phosphorus	0·013	"

About 35 or 40 feet below this tunnel, another tunnel has been run in the same direction for 114 feet into the hill going through limestone and diorite. The last few feet show magnetite, dipping into the hill.

East of this main outcrop, and close to the trail leading down to the main trail up the Gordon valley, several strippings have exposed magnetite, but the work was not sufficient to give an idea of the extent of the ore bodies.

West of the Sirdar a large number of iron claims have been located, adjoining each other for a distance of about 1½ miles along the slope of the Gordon valley. They do not all show magnetite in place, and only the claims on which any development work has been done were examined.

The principal workings are on the claims of the *Conqueror Group*, which are situated on Bugaboo creek, a tributary to the Gordon river, and about 9 miles from Port San Juan. A solid body of magnetite about 40 feet high is exposed in the canyon of the creek. The ore has a maximum width of about 63 feet on the east side of the creek, but becomes narrower on the west side. On the east side the ore-body is stripped for about 80 feet from the creek to a point where it runs under the gravel bank. From the foot of the bluff, a tunnel 14 feet long has been run into the ore, and shows good magnetite. A sample taken along the tunnel gave the following analysis:—

Insoluble matter	4·51	per cent.
Iron	67·09	"
Sulphur	1·60	"
Phosphorus	0·009	"

On the upstream side the ore body is confined by a diorite dike 6 feet wide, which crosses the creek nearly at right angles. Beyond this dike, outcrops of magnetite were noticed on both banks of the creek for a distance of about 60 feet, and on the east side for an additional 15 feet. Along this section in several places the ore seems to lie as a blanket on top of diorite. About 200 feet east of the creek some outcrops of magnetite were reported to have been struck by stripping, but the workings are now caved. Between these strippings and the creek a strong magnetic attraction was noticed in several places. From the existing development it was impossible to get any information as to the extent of the ore-body, or bodies, as the bed rock is overlain by a sandy loam. A magnetometric survey would undoubtedly give a large amount of information.

Reference:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 9–11, No. 47, Mines Branch, Ottawa.

The David mineral claim lies to the east of the Conqueror, and adjoins the Sirdar on the west side. Within a distance of 400 feet on the slope, some strippings have exposed good magnetite in several places, but the work is not sufficient to warrant any estimate being made of the value of the deposits. On a few *other claims* in the same area several outcrops of magnetite were noted.

Rose claim is situated on the north bank of the Gordon river, about 5 miles from Port San Juan. On a small outcrop of magnetite a shaft has been sunk to a depth of 300 feet. About 100 feet from the collar, a cross-cut 40 feet long has been run to the north, passing through 18 feet of magnetite mixed with rock. Similar cross-cuts have been run on the 200 and 300-foot levels, the 200-foot level being (1902) about 18 feet long, and the 300-foot level less than 18 feet long. In neither of these lower cross-cuts, nor in the shaft, was any ore visible. The rock passed through was chiefly diorite, and these cross-cuts have not been driven far enough to strike the ore-body cut on the 100-foot level, should it continue to this depth on the dip at the surface.

Going up the Gordon river from the Rose claim for a distance of three-quarters of a mile, several strippings and trenches, some of them showing magnetite, were noticed on both banks. The development work done has not proved the ore to be of any extent. On the contrary, the workings show a number of small discontinuous bodies situated roughly along the contact of limestone and diorite.

The *Sirdar mineral claim* is situated 2 miles farther up the valley than the Rose, and the ore occurrence is very similar to that on the Baden Powell and Little Bobs. The magnetite outcrops along the face and brow of the ridge for about 160 feet.

About 50 feet below the top of the ridge a tunnel has been run 103 feet into the hill, showing the width of the ore to be about 82 feet. An average sample taken along the tunnel gave the following analysis:—

Insoluble matter	8·52	per cent.
Iron	56·57	„
Sulphur	2·75	„
Phosphorus	0·121	„

MALAHAT MOUNTAIN.

Malahat mountain forms a portion of the divide between Shawnigan lake and Saanich arm, and is most easily reached from Shawnigan Lake station on the Esquimalt and Nanaimo railway. A series of claims has been located across this divide, extending towards and reaching almost to tide water on Saanich arm.

The *Chemainus mineral claim* is situated below and adjoins the Jumbo claim. A shaft has been sunk for 20 feet on an outcrop of magnetite mixed with a little copper pyrites.

The *Jumbo mineral claim* is situated on the Shawnigan lake slope of the divide, at an elevation of about 1,385 feet above sea level, or 900 feet above the railway. A tunnel has been run into the hillside below an outcrop of magnetite. At 30 feet in, this tunnel cuts a well defined deposit of nearly solid magnetite, dipping into the hill at an angle of about 30 degrees. The face of the tunnel was still in solid ore, the hanging wall not having yet been reached. The outcrop was not such as to give any idea of the thickness of the ore-body, and more work is required to be done in the tunnel to prove the actual thickness of the deposit. The ore on the small dump at the tunnel portal shows magnetite in places mixed with some arsenical iron pyrites and a little copper pyrites.

The *Malahat mineral claim* is situated on the summit of the divide about 1,100 feet above the railway or 1,600 feet above sea level. A tunnel has been driven for some 18 feet in a dark diabasic rock, and at the face a winze has been sunk 6 feet. The rock in the winze is a coarse-grained diorite, enclosing bands of solid magnetite a few inches wide, but not revealing any ore-body of commercial importance.

The *Star mineral claim* lies 1¼ miles east of the Malahat claim, and on the Saanich slope of the divide. A surface stripping has exposed some magnetite, but a tunnel driven into the hill, about 30 feet below this outcrop of magnetite, failed to reveal any ore, going through diorite with occasional streaks of lime.

Reference:—
Report of Minister of Mines, B.C., 1902, pp. 221—222.

SALT SPRING ISLAND.

On the northwest slope of *Mount Sullivan*, on Salt Spring island, magnetite occurs in a sheared zone in a highly schistose rock. The zone is about 100 feet wide, and is filled with finely crystalline jasper, giving the rock a reddish appearance. The iron ore is found chiefly towards the centre of the zone, and generally in narrow bands of almost pure magnetite up to three inches wide. The magnetite also occurs in irregular lenses enclosed in micro-crystalline quartz. Some of the magnetite has been altered to hematite. The zone contains fragments of the sheared rock in it with numerous minute seamlets of quartz, and sulphides are absent.

Reference:—
J. A. Allan, Summary Report, Geological Survey, 1909, pp. 101–102.

SOOKE HARBOUR.

Sooke Harbour is situated at the southwest end of Vancouver island, about 20 miles from Victoria. Several claims have been taken up in this locality in search for iron ore. The ore deposits consist of irregular segregations of pyrrhotite, magnetite, pyrite and chalcopyrite in gabbro, and are of no economic importance as a source of iron ore.

Reference:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, p. 9, No. 47, Mines Branch, Ottawa.

Alberni Mining Division.

ALBERNI CANAL.

Alberni canal forms the inland extension of Barkley sound, and is accessible by rail from Victoria and Port Alberni.

The *Darby and Joan mineral claims* are reached by a good trail from Smith's landing, about a quarter of a mile long. Some surface strippings and a few open-cuts have exposed a body of magnetite, which, running approximately north and south along the hill, can be traced about 115 feet. The width of the ore is about 11 feet, but decreases towards the north end, where it is only 6 feet. North of the main outcrop, several open-cuts and tunnels have been run into the hill, but have exposed only a dark to light green diorite. No magnetic attraction could be noticed north of the ore outcrop, but the attraction was strong to the south of it, for a distance of about 70 feet. An average sample of the ore dump gave the following analysis:—

Insoluble matter	25·95	per cent.
Iron	50·96	„
Phosphorus	0·004	„
Sulphur	0·083	„

The *Defiance mineral claim* is situated on the north shore of Alberni canal, about one mile east of Uchucklesit bay at an elevation of about 850 feet above sea level. Surface stripping had partly uncovered 2 lenses of magnetite, and each exposure shows a length of about 65 feet.

At one point one of the ore-bodies has been cut by a creek, exposing the ore to a depth of about 12 feet. From a width of about 6 or 7 feet which the ore has at the upper part of this cut, it pinches to about 2·5 feet at the bottom. An average sample of the ore gave the following analysis:—

Insoluble matter	4·37	per cent.
Iron	66·89	"
Phosphorus	0·024	"
Sulphur	0·060	"

East of these main outcrops several others were noted, with very irregular shape, and carrying in places some copper pyrites. One had been stripped for about 30 feet, exposing a width of 17 feet. By a creek cutting through it at the north end, it was shown to be of blanket form, 3 feet thick, resting on limestone, although at the contact of the limestone and the igneous rock it went down somewhat deeper, with indications of pinching out.

The Iron Mountain mineral claim is situated on the west shore of Anderson lake, which empties through a short river into Uchucklesit bay, on the north side of Alberni canal. Some surface stripping has been done here on the east bank of a small creek, showing patches and bands of magnetite in diorite. Farther up the hill other workings were noticed, but none giving any evidence of containing magnetite in commercial quantity.

Reference:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 13-14, No. 47, Mines Branch, Ottawa.

Cascade Mountain.

Black Prince No. 2 mineral claim is situated on Cascade mountain, 22 miles from Alberni. The ore is exposed by a stripping 50 feet square, and by one open cut 36 feet long, 9 feet wide and 8 feet high. The width of the ore body on the surface is stated to be 40 feet.

Reference:—
James Wilkinson, Alberni, Vancouver Island, B.C., 1914.

Copper Island.

Tzartos, or Copper island as it is known locally, is the largest of a chain of islands running northeast and southwest in Barkley sound, which separates the east and west channels. Several iron claims have been staked, and they can best be reached from Clifton point, near the middle of the east coast of the island. Test-pits are found at intervals over a great area.

The most important development work has been done on the *Mountain claim*, situated a short distance inland from Clifton point, and about 700 feet above sea level.

The workings show that the magnetite is of very irregular extent, and give no evidence to warrant further development.

An analysis of the ore is as follows:—

Insoluble matter	16·52	per cent.
Iron	52·09	"
Phosphorus	0·025	"
Sulphur	0·230	"

References:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, p. 12, No. 47, Mines Branch, Ottawa.
Report of Minister of Mines, B.C., 1902, p. 223.

Santa Maria Island.

An occurrence of magnetite is reported on Santa Maria island, opposite the mouth of Sarita river. Near the south end of the island, at high water mark, there is a shaft filled with water, from which many years ago iron ore was mined. The shaft was sunk on a small exposure of magnetite mixed with sulphides.

References:—
Report of Minister of Mines, B.C., 1896, pp. 4-5.
Bell, Geological Survey of Canada, Vol. XV., 1902-1903, p. 63A.

Sarita River.

The *Sarita river* flows into the eastern channel of Barkley sound, twelve miles from Cape Beale, and directly opposite Copper island. About a mile up the river, and about a quarter of a mile back from the south bank, magnetite outcrops on a ridge running east and west parallel with the river. The height of the ore bluff is about 60 feet; the width could not be obtained, but the ore encloses in several places a greenish metamorphic rock and crystalline limestone, which seems to form the foot wall. A tunnel has been driven at the base of the ore bluff, following the strike of the ore and showing the length of the ore-body to be about 120 feet. In the tunnel on the left side and about 30 feet from the portal, a winze has been sunk 10 feet and bottoms in barren rock. An average sample of the ore gave the following analysis:—

Insoluble matter	3·81	per cent.
Iron	60·89	"
Sulphur	0·76	"
Phosphorus	0·004	"

Following the crest of the hill back in an easterly direction, several strippings and open-cuts were noticed, showing in the majority of cases some magnetite, but the magnetic attraction around and between them is, as a rule, very weak; often there is none, which indicates that the ore is not continuous, but that it occurs rather in the form of pockets, and some of the workings tend to confirm this supposition. At a distance of about 1,000 feet from the main workings, a shaft has been sunk on another outcrop of magnetite. The outcrop is 52 feet long, with a width of about 25 feet, and exposes clean magnetite. The shaft, 21 feet deep, is reported to have struck country rock after passing through 10 feet of ore.

Reference:—

E. Lindeman, Iron Ore Deposits of Texada and Vancouver Islands, pp. 12–13, No. 47 Mines Branch, Ottawa.

SECHART.

Broughton range is situated on the peninsula lying between Pipestem inlet and the middle channel of Barkley sound. The strike of the range is about east and west, and along its slope a number of mineral claims have been located, adjoining each other.

The *Bald Eagle mineral claim* lies to the east of Western Steel. The hillside has been stripped, showing an exposure of magnetite about 70 feet long, with a width of about 30 feet up the slope. Thirty feet below this outcrop a tunnel has been run directly into the hill underneath the surface exposure, and is entirely in an igneous rock, on which the magnetite body apparently rests as a blanket. Farther up the hill the contact between this igneous rock and crystalline limestone was noted, and also a small exposure of magnetite, but the latter was not of sufficient size to be of any importance.

An average sample of the exposure above the tunnel gave the following analysis:—

Insoluble matter	13·36	per cent.
Iron	59·37	"
Phosphorus	0·006	"
Sulphur	0·716	"

The *Crown Prince mineral claim* is situated on the north side of the Broughton range, on the slope towards Effingham inlet, and about 2½ miles from Sechart. The land rises very rapidly from Effingham inlet, and on a bluff about 75 feet high some cross-cutting and stripping has been done, exposing magnetite bodies of irregular shape in a green metamorphic rock. At the base of the bluff two tunnels have been driven into the hillside underneath the outcrop of magnetite exposed on the bluff. After passing through some decomposed rock and limestone, the tunnels expose a fairly good magnetite for 14 to 16 feet.

An average sample of the ore gave the following analysis:—

Insoluble matter	23·22	per cent.
Iron	48·06	"
Phosphorus	0·006	"
Sulphur	0·623	"

There are several exposures of magnetite along the summit and following the ridges in a westerly direction; strong magnetic attraction was noted in places.

The *Western Steel mineral claim* is situated farthest west. Along a distance of about 270 feet several outcrops, strippings, and a shallow shaft show a good clean magnetite.

An average sample of the ore gave the following analysis:—

Insoluble matter	12·76 per cent.
Iron	59·69 „
Phosphorus	0·016 „
Sulphur	0·040 „

Judging from the magnetometric survey the deposits are very pockety in character. (See map No. 438).

Reference:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 14–15, No. 47, Mines Branch, Ottawa.

Clayoquot Mining Division.

Head Bay.

Head bay forms the upper end of Tlupana arm, Nootka sound. On a ridge above the bay four outcrops of magnetite can be seen at intervals along a contact of crystalline limestone and diorite, about one mile inland. These outcrops are from 170 to 200 feet long with a maximum width of from 40 to 55 feet. A little farther south, several smaller outcrops were noted, showing that there is, undoubtedly, a strong mineralization in this area. Up to the present time, no work has been done to show the extent of the ore, with the exception of some stripping and an open-cut, exposing ore with a width of about 55 feet. The ore is of an excellent grade, and a sample taken along the open-cut gave the following analysis:—

Silica	6·10 per cent.
Iron	66·17 „
Sulphur	0·017 „
Phosphorus	0·016 „

Reference:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, p. 16, No. 47 Mines Branch, Ottawa.

Hesquiat Harbour.

This harbour is situated between Nootka and Clayoquot sounds, with Hesquiat lake draining into it through a narrow gorge a few hundred feet long. About 2·5 miles up Hesquiat lake there is a contact of limestone with an eruptive rock, probably diabase. This contact extends across the lake, with a general northwest and southeast trend, and along it are several outcrops of magnetite.

The *Agnes No. 1 and No. 2 mineral claims* are situated on the east shore of Hesquiat lake at an elevation of 175 feet above and some 4,000 feet back from the water. Some outcrops of magnetite have been exposed on the banks of a small creek. They are only a few yards in extent. Assays of average samples gave about 50 per cent iron and 13·1 per cent silica.

The Violet mineral claim is situated on the west side of Hesquiat lake. The principal outcrop is at an elevation of about 300 feet above the lake and less than a quarter of a mile back from it. The exposure of magnetite is about 15 feet wide, developed by an open-cut into the hillside, 12 feet long and about 4 to 5 feet deep at the face. This cut exposes some very clean and solid ore, a sample of which gave 59·8 per cent iron, 11 per cent silica, 0·55 per cent sulphur, and no copper. There is another small exposure of similar ore some 400 feet higher up the hill.

Reference:—

Report of Minister of Mines, B.C., 1902, pp. 208–210.

Kennedy Lake.

Kennedy lake is the largest lake on Vancouver island, and empties through Kennedy river into Tofino inlet. Elk river flows into the lake from the northeast. Between $1\frac{1}{2}$ and 2 miles from the lake shore, on the left side of Elk river, some mineral claims have been staked. In a deep and steep ravine several outcrops of magnetite were noted along the contact of crystalline limestone and granite. No development work has been done to show the extent of the ore-body or ore-bodies. Numerous boulders of magnetite were noticed farther down the valley, some being of considerable size.

A sample of the magnetite gave the following analysis:—

Insoluble matter	7·64	per cent.
Iron	63·07	"
Phosphorus	0·016	"
Sulphur	0·043	"

Reference:—

E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, p. 16, No. 47, Mines Branch, Ottawa.

Maggie Lake.

Magnetic creek runs in a southerly direction, and flows into *Maggie lake.* At a point about 300 feet back from the creek, strong magnetic attraction was noted for a distance of about 300 feet. The surface soil is composed of a sandy loam, and completely covers the bed rock. No indication of magnetite was observed beyond the magnetic attraction. Some pits have been sunk, and a tunnel driven into the bank disclosing nothing but sandy loam.

Reference:—

E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, p. 6, No. 47, Mines Branch, Ottawa.

Quatsino Mining Division.

West Arm, Quatsino Sound.

Deposits of bog iron ore are found one mile west of *Coal Harbour*, on the west arm of Quatsino sound. These lie in and on the border of swampy basins, and partly on the slopes of the adjacent hills. The ore has been exposed by some strippings and open cuts, and a number of outcrops are also visible on the banks of some small creeks. On the hillsides where the accumulation of the limonite has gone on without disturbance, the ore is generally clean and free from other admixture. In other cases some of the outcrops show a mixture of fragments of country rock which have been transported during the wet season from the hills above. The limonite has then been precipitated between the fragments, and the whole now forms a kind of ore breccia. In the swamps, on the other hand, the ore is associated with peat, in layers of varying thickness. In the dry season, the limonite becomes hard and forms a solid crust, which, during the succeeding wet season, will be covered by another layer. The thickness of the ore thus accumulated varies considerably, depending on the supply of ore solution and the topography of the ground; if in a depression the ore may be quite thick, while, with a little elevation of the ground only a few feet from the latter point, none, or only a few inches of ore may be found. Thicknesses from a few inches to 6 feet were noted, and it was reported that in one place 18 feet of ore had been encountered by drilling. The greatest thickness has been found in the vicinity of two creeks on the *Eagle* and *Sunrise* claims.

Average samples taken from two different open-cuts, where the ore was clean, gave the following analyses:—

	I.	II.
Insoluble matter	2·32 per cent.	1·40 per cent.
Iron	54·46 "	56·97 "
Sulphur	0·15 "	0·447 "
Phosphorus	0·038 "	0·038 "

In 1907 one of the most promising deposits was opened up, but it yielded only 1,500 tons of ore, and all the ore down to bed rock was removed. As a result of the disappointing yield from the deposit exploited there has been no iron ore mining done in the locality since.

References:—
E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 17–18.
Report, Minister of Mines, B.C., 1907, p. 149.

Nanaimo Mining Division.

Klaanch River.

Nimpkish lake is 15 miles in length, with an average width of rather less than a mile. It empties at the north end through Nimpkish river into Broughton strait, at a point directly opposite Alert bay. At the south end Klaanch river flows into the lake from the southeast. About 7 miles up this river, and on the south side of it, several claims have been staked, showing some magnetite.

The *Iron Crown mineral claim* shows an exposure of magnetite extending along the face of the river bank for some 180 feet. The height of the bank is about 80 or 100 feet, forming at some points, cliffs of magnetite 25 to 30 feet high. A sample of the ore gave the following analysis:—

Insoluble matter	4·12	per cent.
Iron	64·23	"
Sulphur	0·233	"
Phosphorus	0·010	"

Farther up the hill, about 650 feet back from the river, several outcrops of magnetite occur along the ridge. An average sample from these gave the following analysis:—

Silica	5·30	per cent.
Iron	63·89	"
Alumina	1·74	"
Lime	0·80	"
Magnesia	1·86	"
Copper	Trace.	
Sulphur	0·017	"
Phosphorus	0·021	"

Judging from the magnetometric survey there are three deposits or groups of deposits on this claim, which for reference have been numbered I, II, and III. (See map No. 442).

Group I outcrops on the river bank, as before stated. The top of the bank is covered with soil, and no work has been done to ascertain the width of the deposit; but to judge from the magnetic curves and outcrops available, the width at the west end may be estimated at not less than 100 feet. The length of the ore-body may be assumed to be about 190 feet.

Group II is the most important, and may be assumed to consist of two or possibly three ore-lenses, not counting the small pockets in the southern part of the group. The largest of these ore-lenses has a length of at least 380 feet, with a probable width of 60 feet.

Group III is altogether covered by soil and drift. The magnetic curves show, however, that the ore-body strikes about parallel with the former group, with a length of about 480 feet, and a width which, in places, may be assumed to be very little less than that of Group II.

Reference:—

E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 19-20, No. 47, Mines Branch, Ottawa.

Quinsam River.

Quinsam river is a tributary of Campbell river, which flows into the strait of Georgia at a point about 35 miles north of Comox, and directly opposite the south end of Valdes island. The mineral claims are situated on a tributary of the Quinsam river about 13 miles from the coast.

Magnetite outcrops here on the north bank of the river, in a bluff about 80 feet high. Part of the face of this bluff has been stripped for 33 feet in width, showing solid magnetite, without having uncovered the contacts with the country rock. About 40 feet above the river a tunnel has been driven into the hill, following the strike of the ore. The tunnel was 60 feet long and entirely in magnetite.

A sample taken along the tunnel gave the following analysis:—

Silica	7·00 per cent.
Iron	56·45 "
Alumina	2·07 "
Lime	3·77 "
Magnesia	1·25 "
Phosphorus	0·017 "
Sulphur	0·53 "
Copper	0·70 "

Another sample taken across the face of the bluff above the tunnel gave the following analysis:—

Insoluble matter	11·00 per cent.
Iron	59.77 "
Sulphur	0·533 "
Phosphorus	0·024 "

Following the crest of the ridge in a north-northwest direction, some outcrops and surface strippings were noted. These indications and the strong magnetic attractions, show the ore to be continuous for a distance of about 350 feet. The ore is generally free from admixture with country rock, though containing some sulphides of copper and iron. On the south side of the river, some small outcrops of magnetite may be seen along the slope.

Reference:—

E. Lindeman, Iron Ore Deposits of Vancouver and Texada Islands, pp. 20–21, No. 47, Mines Branch, Ottawa.

SEYMOUR INLET.

Magnetite occurs near the head of the inlet on the east shore opposite Wigwam bay.

Reference:—

R. Graham, Geological Survey of Canada, Summary Report, 1908, p. 40.

TEXADA ISLAND.

Texada island, a partly submerged ridge, lies in the strait of Georgia, paralleling the mainland coast at a distance of from 2 to 4 miles. It has a length of 30 miles, with an average width of about 3 miles. The greatest elevation is Mount Sheppard, 2,892 feet above sea-level.

On the southwest coast of Texada island numerous outcrops of magnetite occur to the northwest of Gillies bay. Near the northeast coast many deposits are located in the neighbourhood of *Raven bay*, and extend in diminishing number south to Pocohontas mountain and northward to Sturt bay. The lenses are all of moderate size and vary in shape from rounded irregular masses to long vein-like forms. They occur in the main limestone area, associated with small limestone inclusions in the porphyrite, and in the porphyrite itself.

The *Puget Sound Iron Company's Mines:* (See Vol. I, page 25).

From the *Paris claims* near Blubber bay and the *Volunteer* near Sturt bay, small shipments of magnetite carrying a little copper have been made.

Reference:—
R. G. McConnell, Geological Survey of Canada, Memoir 58, pp. 66, 67 and 90.

WALKER ISLANDS.

Magnetite is reported to occur on one of the islands of the Walker group, in Queen Charlotte sound, near the north end of Vancouver island.

Reference:—
Dawson, Geological Survey of Canada, Vol. III, 1887–88, p. 101 R.

WEST REDONDA ISLAND.

The *Elsie mineral claim* is situated on the north shore of West Redonda island. The magnetite outcrops about 450 feet above sea level, and occurs along the contact of granite and crystalline limestone. An open cut [illegible] feet long extends into the magnetite for 20 feet. In part the ore is solid, but in general it occurs as nests and stringers in the limestone. At two other points on one claim magnetite has been exposed. An analysis of pure material by A. O. Hayes gave—iron 71·28 per cent, silica 0·89 per cent. In 1893, 626 tons were mined and shipped to the Oswego Iron and Steel Company's furnace in Oregon.

The *Black Warrior group*, consisting of the Black Warrior, Eagle, Homestake and Bonanza mineral claims, is situated on the north shore of West Redonda island, and adjoins the Elsie. The ore is magnetite. No work has been done beyond some stripping and the commencement of a tunnel. One ore-body has a width of 30 feet, and outcrops at three points, along an estimated length of 500 feet.

References:—
Report of Minister of Mines, B.C., 1901, p. 1113.
J. A. Bancroft, Geological Survey of Canada, Memoir 23, pp. 131–133.

II. QUEEN CHARLOTTE ISLANDS.

Queen Charlotte Mining Division.

GRAHAM ISLAND.

On Graham island lenses of clay ironstone are reported to occur in shales and sandstones of the Cretaceous period, but since they are small and of limited distribution, it is very improbable that they will ever furnish any ore.

References:—
Marshall, T. R., Minister of Mines Report, B.C., 1902, p. H 55.
Clapp, C. H., Geological Survey of Canada, Summary Report, 1912, p. 29.

Louise Island.

The *Cumshewa iron deposits* are situated on the north slope of Louise island, about 1½ miles south of Cumshewa inlet, and about 1,100 feet above sea level. The development consists of shallow test-pits and a tunnel 60 feet long. The extent of the ore-body or ore-bodies has not been determined, but "float" has been picked up along the apparent strike (N.W. by S.E.) for a distance of over 4,000 feet. The ore is magnetite and the average analysis of 22 samples is as follows:—

Iron	68·00	per cent.
Silica	1·20	"
Phosphorus	0·008	"
Sulphur	0·01	"
Lime	1.00	"

It is estimated that the ore can be mined and delivered on board ship for 75 cents per ton, and that it can be shipped to Philadelphia via the Panama canal for $3.50 per ton.

References:—
Report of Minister of Mines, B.C., 1911, p. 77.
H. K. Owens, Empire Building, Seattle, Washington, for Cumshewa Iron Mines, Limited.

On the *Kildoo, Indian Woman, Darling, and Edar claims*, there are a few ore deposits exposed by trenches, strippings, and a tunnel 59 feet in length. The ore is magnetite very heavily impregnated with sulphides.

Reference:—
R. H. Flaherty, Port Arthur, Ontario, 1912.

Moresby Island.

Collison Bay. The country rock in the vicinity of Collison bay is a massive hornblende porphyrite, holding some small limestone inclusions, and cut by numerous dikes. The mineral showings consist of 7 vein-like leads, the main lead having been stripped for 150 feet, and uncovered at intervals for 800 feet. Its width varies from 1 to 5 feet, but it swells out to 12 feet at a point known as the *Gordon cut.* The vein filling is mostly magnetite, but varies greatly along the strike, and consists in places of chalcopyrite and pyrrhotite in a gangue of altered country rock. Considerable development work has been done, but the results so far have been disappointing.

The *Meal Ticket mineral claim* is near the foot of the ridge bordering Collison bay on the northwest, at an elevation of 225 feet above sea level. A lens of magnetite occurs in porphyrite having a thickness of from 3 to 8 feet, and is exposed on the hillside for a distance of about 200 feet. The principal minerals associated with the magnetite are chalcopyrite, pyrrhotite, epidote, garnet, and quartz.

The *Princess group* is situated at an elevation of 1,500 feet above sea level on the crest of a ridge overlooking Carpenter bay. The rocks consist of a wide granite dike cutting basic igneous rocks, and occasional outcrops of crystalline limestone. A lens of magnetite about 45 feet in length and 18 feet in width, holding considerable chalcopyrite at one point, outcrops a short distance below the summit of the ridge at the contact of the two intrusives. The principal development work consists of a tunnel driven through the magnetite lens and for some distance into the country rock beyond. A strong lead showing magnetite in places also crosses the summit, and is exposed by small open cuts.

Reference:—
R. G. McConnell, Summary Report of Geological Survey, 1909, pp. 74–76.

Jedway.

The *Dingo mineral claim* shows a lens of magnetite 10 to 15 feet in width. The lens is exposed by surface cuts at two points about 60 feet apart, and is said to be traceable for a considerable distance. The surface exposures contain little or no copper.

Magnetite lenses also occur on the *Reco*, *Modoc*, and *other claims* in the vicinity.

The *Iron mountain or Magnet mineral claim* is situated about a mile from Jedway on Harriet harbour, on the divide between it and Huston inlet, at an elevation of about 1,300 feet above sea-level. A large magnetite body about 400 feet in length, with a width at one point of fully 100 feet, is exposed on this claim. The magnetite is enclosed in porphyrite, except at the north end, where some crystalline limestone is exposed. It is unusually free from impurities, on the surface at least, but contains some garnet, epidote, calcite, and cores of more or less altered country rock. Iron and copper sulphides in small quantities and some hornblende are also irregularly distributed through portions of the mass. The development work consists of some stripping, a cross-cut, and a short tunnel along the footwall.

Reference:—
R. G. McConnell, Summary Report of Geological Survey, 1909, p. 78.

Klunkwoi Bay and Vicinity.

The *Apex mineral claim* is situated about a mile southeast of Lake Anna, near the crest of a high ridge, with a general elevation of about 2,700 feet.

The rocks exposed on the claim consist of a lime wedge about 300 feet wide on the surface, enclosed in a greyish granitic rock, and both are cut by porphyrite dikes.

A short distance below the sharp crest of the ridge, a large magnetite lens outcrops on the south slope, and apparently extends through the ridge, which is about 400 feet across, as a similar magnetite body is exposed at about the same elevation on the north slope. The lens on the south slope has a maximum width of 50 feet, and can be traced up the mountain side for a distance of about 100 feet. On the north slope the maximum width is 125 feet and the height about 60 feet.

The magnetite includes a number of limestone cores, and also small areas made up mostly of garnet and calcite. It is stained nearly everywhere on the surface with copper carbonates, and in places chalcopyrite is fairly abundant. The copper tenor, judging from the surface exposures, seems important, but the percentage is not known as practically no work has been done on the claim.

A second large magnetite mass is situated on a ridge about half a mile west from the Apex lode. Only small quantities of copper are visible in the surface exposures.

The *Copper Belle mineral claim* is situated in a high basin north of Apex mountain, and is crossed by a strong porphyrite dike. The outcrop consists of a magnetite lens about 20 feet in width bordering the dike. The ore carries considerable chalcopyrite in places.

Reference:—
R. G. McConnell, Geological Survey of Canada, Summary Report, 1909, pp. 78–79.

TASU HARBOUR.

The Warwick group of mineral claims is situated south of the entrance to the south arm of Tasu harbour, and is about 8 miles from the end of the Lockeport trail at the head of Botany bay. The principal workings are at an elevation of 1,160 feet above the sea, and 2,000 feet back from it in a direct line.

The country rock is a dark, medium-grained hornblende porphyrite, holding a large inclusion of crystalline limestone. The mineral showings occur partly in the limestone and partly in the porphyrite, and consist of magnetite in unusually large masses, associated with chalcopyrite, pyrite and pyrrhotite.

Besides considerable surface work, consisting of trenching, stripping, and open-cuts to define the ore-bodies, a tunnel 100 feet in length has been driven into the main magnetite mass. The tunnel section consists mainly of magnetite, interrupted at one point by a band of limestone 15 feet in width, which is cut by several dikes. Magnetite interbanded with limestone is also shown by surface exposure to extend 100 feet beyond the end of the tunnel. The full length of the ore body is not yet known.

The magnetite is associated with chalcopyrite in grains and bunches, pyrite, and pyrrhotite. The copper sulphides occur somewhat plentifully in the magnetite near the portal and face of the tunnel, and in smaller quantities near the central portion.

A second magnetite mass, which has apparently developed in porphyrite, as no limestone was seen, occurs 800 feet northwest of the one tunnelled. It has not been fully defined, but is of large size—fully 100 feet in width and 200 feet in length, at least. Magnetite outcrops, probably marking a line of lenses, are also stated to extend down to the beach.

Reference:—
R. G. McConnell, Geological Survey of Canada, Summary Report, 1909, pp. 80–81.

III. MAINLAND.

Atlin Mining Division.

RANT MOUNTAIN.

On *Rant mountain*, a range running parallel and adjacent to Chilkat river, and about two miles from Wells, a large deposit of magnetite is reported to occur having an iron content of over 50 per cent.

Reference:—
Report of Minister of Mines, B.C., 1902, p. H 42.

Skeena Mining Division.

IRON MOUNTAIN.

A large deposit of magnetite is reported on *Iron mountain*, in the Kitimat section of the Skeena division.

Reference:—
Report of Minister of Mines, B.C., 1909, p. 57.

Omineca Mining Division.

THE NORTH PACIFIC IRON MINES.

This group, consisting of nine claims (375 acres), and owned by the North Pacific Iron Mines, Limited, Prince Rupert, is situated in the Omineca Mining Division near the head waters of Summit creek, a tributary of Copper river. The property is about 38 miles east of Copper city, which is situated on the Grand Trunk Pacific railway at the junction of the Copper and Skeena rivers. The deposits consist of bedded bog iron ore, lying parallel to the surface of the hill at an angle of 30 degrees. The ore has been exposed by burning off the trees and moss, and by a number of large open-cuts and smaller pits. The greatest thickness of ore exposed is 15 feet. In two places 10 feet is exposed and several places show from 3 to 4 feet. In no place has the bottom of the ore been reached. The overburden consists merely of moss and trees, and the ore lies from 6 inches to 2 feet below the surface.

The total area underlain by the ore is estimated at 2,200,000 square feet, and allowing 180,000 tons per foot of depth, and an average of 5 feet over the area, the probable ore amounts to 900,000 tons, though it is probable that twice that amount of ore might be assumed (J. D. Mackenzie).

Another estimate of 7,500,000 tons has been made by assuming an average thickness of 15 feet of ore over 200 acres (J. V. Rittenhouse).

The following analyses have been made:—

	I	II	III	IV
Iron	56·01	51·00	50·60	54·00
Silica	0·83	2·00	1·70	1·04
Phosphorus	0·016	nil.	nil.	0·002
Sulphur	1·52	1·70	0·80	1·15
Manganese	0·51	....	....	

I. Sample. Wall of trench. J. D. Mackenzie.
Analysis. Chemistry Division, Mines Branch, Ottawa.
II. Sample. Depth, 15 feet. W. M. Brewer.
Analysis. Bureau of Mines, Victoria.
III. Sample. Given to W. F. Robertson by J. V. Rittenhouse.
Analysis. Bureau of Mines, Victoria.
IV. Sample. Depth, 25 feet. J. V. Rittenhouse.
Analysis. Falkenburg and Laucks, Seattle.

References:—
Report, J. V. Rittenhouse for the Company.
Report, J. D. Mackenzie, Geological Survey of Canada, Summary Report for 1915.
Annual Report, Minister of Mines, B.C., 1914, p. 123.

Bella Coola Mining Division.

Rivers Inlet.

An occurrence of magnetite is reported on the north side of *Rivers inlet*, about 25 miles up from its entrance.

References:—
Dawson, Geological Survey of Canada, Vol. III, 1887–88, p. 101 R.
Graham, Summary Report, Geological Survey, 1908, p. 40.

Clinton Mining Division.

The *Chilcotin hematite mines*, consisting of about 12 claims, are situated about 65 miles from tidewater, and at an elevation of about 7,000 feet above sea level.

This property has been developed by three open-cuts, one being 100 feet wide in solid ore. The other cuts are 50 by 100 feet and 30 by 30. There are two ore bodies, one of which has been cut by a cross-cut tunnel, and a tunnel is now being driven to cut the second. The ore is a massive hematite of the following composition:—

Iron	61·50	61·60	57·38
Silica	6·72	10·20	16·33
Phosphorus	0·05	0·05	0·128
Sulphur	0·12	0·10	0·030
Manganese	....	....	0·07

Reference:—
Peter Wallace, President of The Hematite Mining Company, Limited, Box 362, Vancouver.

Lillooet Mining Division.

Green Lake.

About 22 miles from Pemberton meadows on the side of the trail between the meadows and Squamish, immediately north of Green lake, several mineral claims have been staked on a deposit of bog iron ore.

The *Iron Mask mineral claim* contains a deposit of bog iron ore that extends over a considerable area, and has been slightly prospected on the surface by a number of open-cuts, the largest of which is about 20 feet long, which has developed ore to a depth of from 2 to 3 feet. A sample taken of the ore exposed in the cut gave, upon assay:—

Iron	48·0	per cent.
Silica	2·2	"
Sulphur	0·2	"
Phosphorus	0·1	"

The area over which iron is found is of considerable size, but the work done is insufficient to demonstrate the depth of the deposit, and consequently its size. The locality is at present accessible via the Pacific Great Eastern railway, which extends northwesterly from Squamish on Howe sound.

Reference:—
Wm. F. Robertson, B.C., Minister of Mines Report, 1910, p. 147.

Iron Creek.

Deposits of iron ore have been located on the west side of Whitewater river and along Iron creek. Those of Iron creek were examined by A. M. Bateman, of the Geological Survey, in 1912. These claims were staked in 1911, and practically no work has been done upon them. They cover the valley of Iron creek, an easterly tributary of Whitewater river, and are located at an elevation of 6,400 feet above sea level.

The deposits consist of bog iron ore of a yellowish-brown colour. The ore occurs as a hard compact limonite, as a cement in the consolidated talus, and in a light porous state replacing moss and leaves. The deposits are from 2 inches to 5 feet thick, and cover scattered patches of the bottom and sides of the valley. They are irregular in extent and thickness, and while 5 feet of solid limonite may be found in one place, in another spot, a few feet away, there may be only a superficial stain. These patches and intervening spaces of stained rock cover the valley for a width of 1,000 feet and a length of about a mile.

The bog iron ore is of local origin and is derived from the decomposition of disseminated pyrite, contained in a bed of rhyolite which outcrops on the adjacent hillside. These bog iron ore deposits cover a considerable area, but are very scattered and of no great thickness, and this, taken into consideration with the low percentage of iron in the ore, the altitude of the deposits, and the distance from transportation, would place their development beyond the reach of present commercial possibilities.

Similar deposits of bog iron ore occur west of *Whitewater river*, in *Schwartz valley*, and around the head waters of *Gun creek*.

Reference:—
A. M. Bateman, Summary Report of Geological Survey, Canada, 1912, p. 186.

Ashcroft Mining Division.

Lytton.

On the east side of the Thompson river, about 6 miles southeast of Lytton, there is a group of claims on which there are a few showings of iron ore. The ore is magnetite, and it lies in layers between gneiss in a nearly horizontal position. The thickest bed is 19 feet, and the others are much thinner.

Reference:—
L. B. Cleaves for R. H. Flaherty, Port Arthur, Ontario, 1912.

Nelson Creek.

On the *Iron King claim* at the head of Nelson creek, 12 miles from Ashcroft, there is a deposit of fine, granular, massive magnetite. No information concerning the size of the deposit is available, but a sample from it submitted by O. E. Leroy was found on analysis to contain:—

Iron	64·60	per cent.
Silica	5·40	„
Sulphur	trace.	„
Phosphorus	0·148	„

Reference:—
Mines Branch, Ottawa, Division of Chemistry, 1915.

Kamloops Mining Division.

Glen Iron Mine (See Vol. I).

Nicola Mining Division.

On the summit of the range northeast of *Coutlee*, a small deposit of specular hematite was opened several years ago, but found to be irregular and of but small extent. On the summit of *Iron mountain*, also, small irregular veins of similar ore were observed, but the observed quantity did not appear to be of economic importance. A small and irregular deposit was also seen on the north flank of the hill south of *Coutlee*. The ore is specular hematite, but the occurrence is unimportant.

Reference:—
Ells, Geological Survey, Vol. XVI, 1904, p. 49 A.

Hematite is reported as occurring 2 miles southeast of *Nicola*. The ore is stated to be of excellent grade, and has been exposed by a few surface cuts. The ore-body or ore-bodies are thought to be small.

Reference:—
A. W. McVittie, Victoria, B.C.

Arrow Lake Mining Division.

An occurence of magnetite is reported on the north bank of the *Kootenay river*, about half a mile below the lower fall, as the Kootenay is ascended from its junction with the Columbia river. No ore has been found in situ, but large blocks of magnetite weighing several tons are scattered in the valley.

Reference:—
Dawson, Geological Survey of Canada, Vol IV, 1888–89, pp. 65–66 B.

Nelson Mining Division.

Gray Creek.

The *Bismark and Gladstone mineral claims* are in the vicinity of Gray creek. It is stated that an 8-foot vein of clean specular hematite outcrops on these claims, and has been opened up by a series of open cuts.

Reference:—
Report, Minister of Mines, B.C., 1902, p. 163.

The ***Kitchener*** hematite deposits are situated on Goat river, about $6\frac{1}{2}$ miles north of Kitchener station on the Canadian Pacific railway. Considerable prospecting work has been done, consisting of open cuts and three shafts. Five beds of hematite are reported to have been uncovered having widths of 8, 12, 18, 15, and 6 feet respectively. They occur in quartzite. An average of over 100 assays of the ore is reported to have given 50 per cent of metallic iron, with both sulphur and phosphorus in negligible quantities. The deepest shaft is 45 feet, and in this work every sample showed over 60 per cent in iron and some as high as 69 per cent. No information regarding the quantity of the ore is available. The property is controlled by Sir Thomas Shaughnessy and associates.

Reference:—
W. Blakemore, B.C. Minister of Mines Report, 1901, p. 1033.

Iron Range mountain lies to the north of the Kitchener deposits. A vein was uncovered in about twenty places along the strike, showing a thickness of from 8 to 18 feet. The ore is hematite, assaying 58 per cent metallic iron.

Reference:—
Report, Minister of Mines, B.C., 1902, p. 163.

Fort Steele Mining Division.

Bull River.

Bull River Iron Mines.

The Bull river hematite deposits are situated on the southeast side of Bull river, about 10 miles north of Jaffray on the Crowsnest branch of the Canadian Pacific railway, and they are reached by a wagon road and trail from Bull river station on the Elko-Golden branch of the Canadian Pacific railway.

The deposits occur in a series of siliceous dolomites striking north and south, and dipping 30 degrees to the east. They appear to be replacements of the dolomites, and they have no clean cut boundaries. All transitions from good ore to non-ferruginous country rock are observable. The thickness of ore in exposures varies from 10 to 20 feet, but a part of each deposit is always lean. The deposits are found over an area of one-half square mile. The small amount of development work prevents one making an estimate of tonnage.

Samples of ore from these deposits are reported to have had the following analyses:—

	I.	II.	III.	IV.	V.
Iron	50·00	62·80	50·60	50·00	61·70
Silica	20·00	6·60	25·00	22·70	8·80
Sulphur	·08	·04	·03	·18	.....
Phosphorus	·02	None.	·01	·02	.....

References:—
Bell, Geological Survey of Canada, Vol. XV, p. 181 A.
Blakemore, Report of Minister of Mines, B.C., 1901, p. 1007.
Blakemore, Canadian Mining Institute Transactions, Vol. V, 1902, p. 76.
S. J. Schofield, for the Committee, 1915.
James T. Laidlaw, Cranbrook, B.C.

LAMB CREEK.

The *Red Rock mineral claim* is located on Lamb creek near Moyie about 2½ miles from the railway. Limonite or bog iron outcrops in five different places. Only a small amount of work has been done on this prospect. One assay gave an iron content of 44·6 per cent.

Reference:—
A. J. Smith, Moyie, B.C.

SAND CREEK.

Dr. Ings' and Pearson's iron locations are situated along ***Sand Creek***, about 11 miles north of Galloway station on the Canadian Pacific railway. On the Ings group a short tunnel has been driven, and 100 tons of hematite have been mined. On the Pearson group, tunnels have been driven on the Peach, Snowshoe, and Iron Queen claims. The ore showings vary from 3 to 6 feet in thickness. On the Ironton claim of the latter group the ore outcrops on the surface.

Reference:—
Information taken from sketch plan.

MIDDLE WEST PROVINCES.

LIST OF OCCURRENCES INVESTIGATED:—

Alberta.—

BURMIS.

HAND HILLS.

Saskatchewan.—

BLACK BAY, LAKE ATHABASKA.

Manitoba.—

BLACK ISLAND, WINNIPEG LAKE.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED IN THE MIDDLE PROVINCES.

ALBERTA.

BURMIS.

A number of iron claims have been located in the vicinity of Burmis station, about 9 miles east of Blairmore. These claims have been prospected by means of open-cuts along a line extending for about 8 miles northwards from a point near Burmis station. Most of the prospecting has been done near the head waters of Cow creek.

The iron-bearing beds occur interstratified with a series of soft, rather coarse, light-coloured sandstones. On the most northerly claims, where more work has been done, there are at least three iron-bearing beds, of which one shows a thickness of 10½ feet, and is fairly uniform in character. A sample taken across the bed gave the following analysis:—

Iron	39·80	per cent.
Silica	18·33	"
Lime	2·21	"
Magnesia	2·25	"
Titanium dioxide	5·56	"
Phosphorus	0·073	"
Sulphur	Trace	

It would appear that these deposits consist of a number of beds of indurated black magnetic sand, probably in the form of an ancient shore concentration.

Reference:—
W. W. Leach, Summary Report, Geological Survey, 1911, pp. 199–200.

HAND HILLS.

On Red Deer river, west of Hand hills, clay ironstone occurs in the clay and sandstone beds in irregular lenticular bands and nodules. The deposits are unimportant.

Reference:—
Geological Survey of Canada, Vol. II, 1887, p. 150 E.

SASKATCHEWAN.

Black Bay, Lake Athabaska.

A deposit of hematite and limonite is reported on the southeast point of Black bay. Here a conspicuous red hill rises 125 feet above the water. On its northeastern side, at its base, it is composed of thinly fissile quartzose schist, very much reddened, striking N. 30° W., and dipping S. 60° W. at an angle of 10°. Farther up the side of the hill the rock is quartzite, interbedded with layers of hematite, which in some places forms the larger part of the mass. The summit of the hill, several hundred yards in length, is composed of a highly hematitic quartzite, mingled with a large quantity of limonite, especially on the higher points. In places the rock is a conglomerate, with quartz pebbles and a matrix of limonite. Other similar red hills can be seen in the distance on the strike of the rocks.

Reference:—
J. B. Tyrrell, Geological Survey of Canada, Vol. VIII, 1895, p. 61 D.

MANITOBA.

Nodules of carbonate of iron are present in considerable numbers in the Pierre shales, both on the *north side of Riding mountain*, and on the *floor of the Assiniboine valley*. They were nowhere seen in sufficient quantity to be of economic importance. A specimen collected from White Sand river gave 34·07 per cent metallic iron.

Reference:—
J. B. Tyrrell, Geological Survey of Canada, Vol. V, 1890–91, p. 228 E.

Black Island, Winnipeg Lake.

An occurrence of hematite has been reported on Black island. This island is at the north end of the southern expansion of the lake, 54 miles from the mouth of Red river. Along the southeast shore of the island, light green sericitic schists and quartzites outcrop. In these rocks a deposit of hematite is found extending about 300 feet along the shore, rising to a height of 7 feet in the centre of the exposure, and dipping back from the shore at an angle of 30 degrees. The ore is a more or less pure hematite, with numerous little seams and particles of calcite scattered through the mass, along which are also a number of small lenticules of quartz.

No analysis is available representing the average run of the ore, but analyses of specimens show the iron content to range from 53 per cent downwards, with a sulphur content of from 2·02 to 0·07 per cent.

Reference:—
J. B. Tyrrell, Geological Survey of Canada, Vol. IV, 1888–89, p. 16 A.

ONTARIO.

LIST OF OCCURRENCES INVESTIGATED.

ONTARIO.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED.

I. DISTRICT OF RAINY RIVER.

Atikokan Area.

Between Kawene and Atikokan stations on the Canadian Northern railway outcrops of magnetite and pyrrhotite have been found intermittently along the Atikokan river for a distance of about 16 miles. This iron-bearing area is known as the Atikokan Iron Range. The range is geographically broken by Sabawe lake into an eastern and a western portion. The eastern portion extends for a distance of a little over three miles to Attraction lake, and the western for about ten miles to a point a little east of Atikokan station.

Numerous mining locations have in the past been taken up on the range and a considerable amount of prospecting and development work has been done on some of these properties, particularly on locations E 10 and E 11 in the eastern portion of the range. These locations were formerly known as the McKellar property, but are now known as the Atikokan mine.

Eastern Portion of Atikokan Iron Range.

From Sabawe lake to Attraction lake the existence of the iron range is indicated by ore outcrops on the ridges and by magnetic attraction in the drift covered areas. The magnetic belt crosses the following mining locations in order from west to east:—E 24, E 23, E 10, E 11, E 12, E 25, and E 26. Mining locations E 10 and E 11 are the only ones of this group on which any extensive development work has been done. They, together with E 12, are the property of the Atikokan Iron Company, and are known as the Atikokan mine.

Atikokan Mine (Mining Locations E 10 and E 11). (See Vol. I).

Mining locations E 12, E 25, and E 26.

From the east end of the ore deposits on E 11 the ore-bearing belt has been traced eastward over swamp and rock, across mining locations E 12, E 25, and the greater part of E 26. Judging from the magnetometer readings, it has, over this stretch, a width of from 40 to 75 feet, and is continuous, with the exception of two short breaks, for the entire distance. (See maps Nos. 340 and 340A).

Very little work has been done on this part of the range so, while outcrops of the decomposed iron-stained rocks of the iron range are of frequent occurrence, actual exposures of magnetite are small and unsatisfactory, and no opportunity is afforded of getting sections through the magnetic belt, and ascertaining the width of ore in it. Judging by what can be seen, however, it is probable that any ore-bodies will be found to be much smaller than those occurring on E 10 and E 11, and that the sulphur content will be at least as high as it is in E 10 and E 11, where sampling of ore-lenses cut by exploratory tunnels shows the sulphur content to range from 2 to 20 per cent.

Mining Location E 23.

From the westerly end of the ridge on Mining Location E 10, where it disappears under the swamp, the ore-bearing belt has been traced westward by magnetometric readings for 2,400 feet, under deep drift all the way. This takes it across about two-thirds the length of E 23. (See maps Nos. 340 and 340A).

As there are no outcrops nothing definite is known about either the quantity or quality of the ore here. By referring to the nearest cross-section of the ore-bearing belt available (Tunnel A at Atikokan mine), it is seen that the ore there had become highly sulphurous nearly all the way across the belt. This section showed seven feet of ore with 18·81% sulphur, 26 feet with 14·93% sulphur, 34·5 feet with 6·38% sulphur, and 8 feet with 1·30% sulphur.

Western Portion of Atikokan Iron Range.

The western portion of the range extends intermittently from Sabawe lake to within about two miles of Atikokan station—a distance of about ten miles. The existence of ore-bodies has been proven at different points by tunnels, shafts, and diamond drilling; and magnetometric surveys have demonstrated extensions of ore-bodies beneath drift-covered areas. The mining locations in which ore-bodies occur (mentioned in order from east to west) are R 400, R 401, R 402, 212 X, R 403, 139 X, 138 X, and 111 F (near mile-post 140 on the Canadian Northern railway). (See maps Nos. 341, 341A, 342, 342A, 343, 343A).

Mining Locations R 400, R 401, and R 402.

Mining location R 400 is situated about two miles west of Sabawe lake and about one and one-half miles northwest of Hematite station on the Canadian Northern railway.

The claim is 40 chains long and 20 wide, and adjoins claim R 401 to the west, which has about the same area. Both claims are bounded by the Atikokan river, R 400 on its southwest corner and R 401 along the whole extent of its south side.

The two claims are traversed from east to west by diorite intrusives in which magnetite, pyrrhotite and iron pyrite occur either concentrated into irregular lenses or disseminated in small amounts throughout the rock. Outcrops of diorite carrying some magnetite and sulphides of iron are first met with about 1,100 feet east of the boundary line between claims R 400 and R 401. From this place the iron-bearing rock may be traced through claim R 400 into R 401, a distance of 2,200 feet, being specially well exposed near the boundary line between the two claims where the south side of the ridge descends abruptly towards the river. (See maps Nos. 341 and 341A). About 100 feet west of this line and at an elevation of about 35 feet above the river a tunnel has been driven into the steep hill side. The length of the tunnel is 74 feet. About 37 feet in from its mouth a vertical shaft, 52 feet deep, has been sunk. The rock formation exposed by the tunnel consists of diorite with irregular pockets of intermixed magnetite and pyrrhotite or with disseminations of magnetite and pyrrhotite. Average samples were taken from the tunnel by F. Hille, No. 1, sample representing the ore from 6 to 17 feet, and No. 2, the ore from 17 to 34 feet, footage being reckoned from the entrance.

No. 1		*No. 2.*			
Iron	47·48%	FeO	31·18%		
Silica	17·53%	Fe_2O_3	52·37%		
Sulphur	4·47%	FeS_2	2·26%	Iron	62·02%
Phosphorus	0·04%	Al_2O_3	1·30%	Silica	7·33%
		CaO	1·45%	Sulphur	1·26%
		MgO	1·71%	Phosphorus	0·08%
		P_2O_5	0·18%	Titanium	0·10%
		SiO_2	7·33%		
		TiO_2	0·16%		
		H_2O, etc.	1·84%		

In addition to this development work several trenches and cross-cuts have been made at various points along the ridge. The principal open-cut on lot R 400 is 1,050 feet northeast of the tunnel exposing the iron-bearing formation across the hill for a distance of 32 feet. The character of the formation is here the same as that seen in the tunnel. An average sample taken along the cut gave the following analysis:—

Iron	53·10 per cent.
Silica	11·20 „
Sulphur	3·87 „
Phosphorus	0·045 „

A similar open-cut has been made on the hillside towards the river about 450 feet west of the tunnel on claim R 401. The cut is 45 feet long, 4 feet wide and 6 feet deep, trending north and south, and exposing good magnetite in places, but also sulphides of iron, and rock. An average sample taken along the cut gave the following analysis:—

Iron	48·80 per cent.
Silica	16·32 „
Sulphur	3·84 „
Phosphorus	0·088 „

Going westward from this cut the country slopes gently and no outcrops can be seen for a distance of about 1,000 feet. At this point a narrow ridge with a total length of 2,300 feet rises above the surrounding muskeg and extends along the river across the westerly part of claim R 401 into claim R 402 to the west. The greenstone is well exposed on this ridge often exhibiting a rusty appearance owing to the oxidation of iron sulphides with which the rock is heavily charged.

The following analysis represents an average sample taken across the formation at the western end of the ridge. The length of the trench from which the sample was taken is 54 feet.

Iron	38·56	per cent.
Silica	41.97	"
Sulphur	3·50	"
Phosphorus	0·020	"

At the close of exploration work by diamond drilling on these locations in 1906, 1907, and 1908, the following estimates as to tonnages of ore proven were made by the engineer in charge (D. B. Rockwell).

On R 400 and R 401. Magnetic iron ore with impregnations of sulphides of iron, 2,055,000 tons of the following average analysis:—

Iron	52·78	per cent.
Silica	12·61	"
Sulphur	3·16	"
Phosphorus	0·021	"

On R 402 magnetic iron ore and iron sulphides, 264,000 tons of the following average analysis:—

Iron	52·85	per cent.
Silica	10·42	"
Sulphur	10·45	"
Phosphorus	0·053	"

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1908.
E. Lindeman, Mines Branch, Summary Report, 1914.

Mining Locations 212 X and R 403.

Crossing the Atikokan river from Location R 402, and going westward on claim 212 X no magnetic attraction is noticed for a distance of 1,500 feet, when another magnetic area is reached, which has a total length of 2,900 feet and extends from claim 212 X into R 403. (See maps Nos. 341 and 341A). The only exposure of the iron-bearing formation on claim 212 X is in an open-pit near its western boundary line where a considerable amount of pyrrhotite has been exposed. Farther west on claim R 403 the country becomes higher and the iron-bearing formation is found along a ridge rising in places 60 to 70 feet above the river. (See maps Nos. 342 and 342 A). Numerous trenches and test-pits have been made along this ridge, exposing in most cases pyrrhotite with some magnetite and showing the iron-bearing minerals to occur in irregular lenses throughout the diorite. The width of the area within which these lenses occur may roughly be estimated at 100 feet. An average sample taken from one of the trenches gave the following analysis:—

Iron	51·00	per cent.
Silica	2·58	"
Sulphur	15·28	"
Phosphorus	0·025	"

On the conclusion of exploration by trenching and diamond drilling in 1908 and 1909, the engineer in charge (D. B. Rockwell) estimated there had been proven 2,530,000 tons of iron sulphides (chiefly pyrrhotite) of the following average analysis:—

Iron	59·80	per cent.
Silica	3·30	"
Sulphur	20·40	"
Phosphorus	0·025	"

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1909.
E. Lindeman, Mines Branch, Summary Report, 1914.

Mining Locations 139 X and 138 X.

West of the mineralized area in Location R 403, there is no indication of any iron ore deposits for a distance of one mile or before claim 139 X is reached. This claim lies north of the Atikokan river near mile post 135 on the Canadian Northern railway. The iron-bearing formation is here exposed in numerous places along a high ridge which extends from claim 139 X into the adjoining claim 138 X. It consists of the same type of diorite as found on the other claims previously described, with magnetite and pyrrhotite disseminated throughout the rock. In places the pyrrhotite and magnetite are found concentrated into irregular lenses, or pockets. The iron and sulphur content of the ore varies considerably. Diamond drill records show the iron content to range from 62 to 38 per cent, with a variation in sulphur of from 3 to 25 per cent. The phosphorus content is generally low ranging from 0·006 to 0·045 per cent, while the silica varies from 2 to 16 per cent.

Judging from the magnetometric survey the length of the area within which pyrrhotite and magnetite may be found on these two claims is roughly estimated at 2,600 feet with a maximum width of about 250 feet. (See maps 342 and 342 A).

A few hundred feet farther west several small detached magnetic areas indicate the presence of pyrrhotite and magnetite. They are, however, of too small extent to be of economic interest.

After the exploration of these two locations by surface work and diamond drilling in 1908 and 1909 the engineer in charge (D. B. Rockwell) reported that no marketable deposit of ore had been shown up on Location 139 X, and that on Location 138 X there had been proven 1,827,000 tons of iron sulphides (chiefly pyrrhotite) of the following average analysis:—

Iron	55·73	per cent.
Silica	6·67	"
Sulphur	20·38	"
Phosphorus	0·037	"

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1909.
E. Lindeman, Mines Branch Summary Report, 1914.

Mining Location 111 E (near mile-post 140 Can. Nor. Ry.).

This property lies about 5 miles west of Hematite station near mile-post 140 and about 2·5 miles east of Atikokan station on the Canadian Northern railway.

The area covered by the summer's field work is one mile long and 2,000 feet wide, the greater part of which is occupied by basic igneous rocks of the diorite type. In the southern part a typical micaceous slate is well exposed along the railway for a distance of about 2,000 feet. The general strike of the slate is N. 72° E. with an almost vertical dip.

The chief iron-bearing minerals are iron pyrite with some magnetite. They are found disseminated in small amounts throughout the diorite in several detached areas. These areas generally show a rusty appearance owing to the oxidation of the iron pyrite. The principal occurrence is on a hill about 900 feet northwest of mile post 140. The red-brown gossan can here be traced along the top and flank of the ridge for a distance of 600 feet. At the west end a trench, 50 feet long and 5 feet deep, has been made across the top of the hill, exposing a fine-grained rusty-looking basic rock with magnetite and iron pyrite disseminated throughout the mass. An average sample taken along the trench gave the following analysis:—

Iron	39·50 per cent.
Silica	20·10 „
Sulphur	5·37 „
Phosphorus	0·021 „

Judging from the magnetometric survey the total length of this mineralized area is about 830 feet with a maximum width of 110 feet. The magnetic attraction is, however, very irregular within the area, indicating an irregular pockety distribution of the magnetite in the diorite, and giving little encouragement for finding any ore body of economic importance. (See maps Nos. 343 and 343A).

About 800 feet southwest of the area just described another occurrence of gossan outcrops on the top and along the south side of a small hill. It has a length of 350 feet with a width of about 50 feet.

Diamond drilling and trenching on this location in 1909 showed lenses of lean magnetite, but no marketable ore.

Across the Atikokan river to the west of the ore occurrences just described several small areas showing the same rusty looking rock are found on the steep hill immediately south of the railway tracks. Several trenches and test-pits have been made on this hill, but they failed to reveal any ore-body of economic interest.

Commercial Possibilities of the Atikokan Iron Range.

The Atikokan mine was operated, with the exception of brief intervals, from 1907 to 1912 inclusive, and during that time over 90,000 net tons of ore were shipped by the Atikokan Iron Company to its blast furnace at Port Arthur, and there smelted after first being roasted. The average analysis of this crude ore, according to the Company, was as follows:—

Iron	59·85	per cent.
Silica	8·68	„
Sulphur	2·01	„
Phosphorus	0·11	„
Alumina	1·51	„
Lime	3·00	„
Magnesia	2·54	„
Manganese	0·11	„
Copper	0·12	„
Nickel	0·11	„
Titanium	Nil	

On the unexplored portion of the eastern part of the range it is probable that the ore-bodies are smaller than at Atikokan mine, and that they will have at least as high a sulphur content.

On the western part of the range, i.e., on the properties west of Sabawe lake, the conditions are somewhat different. The ores there are generally much higher in sulphur, and on some of the claims the iron-bearing mineral consists exclusively of pyrrhotite, which mineral is not generally looked upon at the present time as an iron ore. By certain parties, however, it is claimed that it is metallurgically possible to roast these high sulphur ores in specially constructed furnaces down to a sulphur content of less than one-half of one per cent. Granting this assumption though, when there is added to the cost of roasting, that of mining (which, owing to the irregular and pockety character of the ores, is likely to be rather high), it seems improbable that the process could be carried out economically at the present time.

References:—

E. Lindeman, Mines Branch, Summary Report, 1914.
A. H. A. Robinson, Mines Branch, Summary Report, 1914.
F. Hille, Mines Branch, Publication No. 22.
D. B. Rockwell, for F. H. Flaherty, Port Arthur, Ont.

Hunters Island Area.

Banded iron formation exposures occur in a small area close to the international boundary, which comprises the extreme southeasterly portion of the district of Rainy River. Occurrences are reported near Knife, Cypress, This Man's, and Jasper lakes, the trend of the band being north-northeast. The formation is composed of jasper interbanded with hematite or magnetite, the bands being usually less than one inch in thickness.

References:—

Geological Survey of Canada, Vol. IV, p. 27 A.
Geological Survey of Canada, Vol. V, pp. 63 and 75 G.
Reports for R. H. Flaherty, Port Arthur, Ont.

Kaiarskons Lake Area.

Kaiarskons lake is located about 10 miles north of the North Arm of Rainy Lake, and about 35 miles north of Fort Francis.

Deposits of siliceous magnetite, with some higher grade lenses, are reported from this locality. They have been slightly explored but no data are available.

Reference:—
A. B. Wilmot, Journal Canadian Mining Institute, 1908, p. 116.

Rainy Lake Area.

Township of Miscampbell.

Iron ore discoveries have been reported from *lots 3, 4, and 5 in concessions I and II of Miscampbell township.* A little exploratory work, consisting of test-pitting, stripping, and diamond drilling, has been done.

Rock outcrops in this area are comparatively few, and all show biotite-granite gneiss. The iron showings consist of small narrow and irregular bands of greyish granular gneiss in which magnetite in small grains is a prominent constituent. The magnetite occurs both disseminated through the bands, and in narrow streaks. The iron-bearing bands are distinctly friable and crush easily, giving a good separation of magnetite from the gangue minerals. The widest band uncovered has a maximum width of 12 feet.

References:—
Ontario Bureau of Mines Annual Report, 1912, p. 27.
A. H. A. Robinson, Mines Branch Summary Report, 1914.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ont., 1912.

Township of Watten.

Mining Locations K 200, K 204, and K 205.

The existence of two deposits of hematite, one 40 feet wide, and one 20 feet wide, separated by a "horse" of quartz is reported on Location K 200. A tunnel, intended to be 150 feet long, and designed to cut the ore-bodies 100 feet beneath the surface outcrops, was discontinued at 65 feet from the entrance. The last 20 feet was in magnetic ore. The following analyses have been furnished:—

	Hematite.	Magnetite.
Iron	59·16 per cent.	66·26 per cent.
Sulphur	0·07 "	0·067 "
Phosphorus	0·588 "	0·018 "
Manganese	0·81 "	0·45 "
Titanium	Nil	Nil.

Reference:—
Private Communication: The Lichen Island Mining Company, Limited, Sarnia, Ontario.

Nickel Lake.

On the south side of Nickel lake the Canadian Northern railway cuts through a considerable stretch of iron formation, consisting largely of granular silica occasionally banded with magnetite, but more often charged with sulphides, especially pyrrhotite. In places the sulphides become massive, hardly anything else being present and one band of pyrites 15 feet thick, just at the shore of Nickel lake, may in the future be of importance as a source of sulphur.

On the northeast shore of Nickel lake opposite to the railway cuttings just mentioned, a banded siliceous rock with much pyrrhotite is exposed on a small island, and a little inland there is a wide belt of granular silica interbanded with magnetite, both with a steep dip as a rule, and a strike of about east and west. The banded silica and magnetite are at least 300 feet wide near the shore of the lake and are present in large amounts a quarter of a mile to the east, where the bands are somewhat contorted, but strike on the whole N. 70° W.

Half a mile farther north a third iron range is reported.

None of the iron ranges contain marketable ore, though some parts of them are strongly charged with magnetite.

Somewhat southeast of Nickel lake and south of Grassy Portage bay, along the line between the townships of Watten and Halkirk, magnetite has also been found, but only in small seams accompanied by pyrite.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1902, pp. 134 and 135.

Lot 6, Concession III.

About half a mile to the southwest of Nickel lake on lot 6, concession III, there is a deposit of magnetite 24 feet wide and 270 feet long with a strike about east and west. It occurs in a slightly schistose greenstone near the contact with a ridge of granite or gneiss. The magnetite is somewhat mixed with green schist fading off into this rock. No analysis of the ore is available.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 135.

Mosher and Horne Iron Locations.

On lots 11 and 12, concession III, considerable surface work has been done, the magnetite deposit being traceable for several hundred feet with a width of about 30 feet, surface samples assaying as follows:—

Iron	49·10 per cent.
Sulphur	0·14 „
Phosphorus	0·019 „

Reference:—
W. E. H. Carter, Ontario Bureau of Mines, 1902, p. 266.

Lots 3 and 4, Concession V.

On these lots small veins, or segregations of magnetite have been found in a very siliceous rock.

Reference:—

A. P. Coleman, Ontario Bureau of Mines, 1902, p. 135.

Township of Halkirk.

Bear's Pass.

Where the Canadian Northern railway crosses Bears pass in Halkirk township a few small outcrops of granular silica with magnetite occur embedded in rusty gneiss. They do not appear to be of any importance, nor are the locations taken up for iron ore to the west of much promise.

Reference:—

A. P. Coleman, Ontario Bureau of Mines Report ,1902, p. 134.

Seine Bay.

Many years ago a large number of iron locations were taken up along the north shore of Seine bay, the northeastern extremity of Rainy lake, the ore being titaniferous magnetite associated with occurrences of a dark hornblende gabbro.

Mining Locations 181 P, 182 P and 183 P.

In 1911 a little surface work and diamond drilling was done on these locations.

References:—

A. C. Lawson, Geological Survey of Canada, Memoir No. 40, p. 42.
L. L. Bolton, for Lake Superior Corporation, Sault Ste. Marie, Ont., 1911.

Mining Locations A. L. 25, A. L. 26 and A. L. 27.

Ore-bodies occur in a ridge extending in a north-northeasterly direction across the northern portion of Claims A. L. 25, 26 and 27. No work has been done to prove the extent of the ore-bodies. Four outcrops which were examined were sampled with results as follows:—

Iron....................	51·34%	41·34%	47·41%	46·81 %
Silica...................	7·80%	11·20%	5·28%	6·02 %
Phosphorus............	0·012%	0·283%	0·007%	0·007 %
Titanium dioxide.......	11·18%	17·36%	23·60%	20·96 %

Reference:—

W. W. Benner for R. H. Flaherty, Port Arthur, Ont., 1910.

Steeprock Lake Area.

Steeprock lake lies north of the Canadian Northern railway in the vicinity of Atikokan station. On the shores of the lake small blocks of pure hematite have been found plentifully. This led to many locations being staked for iron and to considerable exploration by diamond drilling.

The rocks drilled included hornblende and chlorite schists, traps, cherts and siliceous bands of considerable width carrying iron pyrites. No bodies of merchantable ore have been located.

Reference:—
Ontario Bureau of Mines, 1904, Part I, pp. 42 and 43.
Reports for R. H. Flaherty, Port Arthur, Ont.
Reports for Lake Superior Corporation, Sault Ste. Marie, Ont.

Mining Claims F. F. 46 and 51.

On these Claims, located one and one-half miles north-northwest of Elizabeth (formerly Steep Rock) siding on Canadian Northern railway, there are outcrops of iron formation composed of jasper and white, grey and black chert, with very thin streaks of hematite developed in places. No marketable ore was found.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ont., 1909.

Mining Locations 857 X and 858 X (Straw Hat Lake).

These locations were partially explored by the Ontario Government diamond drill in 1902 and 1903 for R. H. Flaherty of Port Arthur. Only siliceous iron formation with pyritic bands was shown up by this work. Additional drilling was done in 1909 revealing limonite in chert, associated with pyritic greenstone and chlorite schists. No marketable ore was located.

References:—
Ontario Bureau of Mines, 1904, Part I, pp. 42 and 43.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ont., 1909.

Turtle River Area.

In 1902 outcrops of banded iron formation of large extent were reported north of Mine Centre (on Canadian Northern railway) on an expansion of the Turtle river. No additional information is available.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 136.

II. DISTRICT OF KENORA.

Winnipeg River Area.

Iron locations are reported to have been taken up north of Kenora, on the east side of the Winnipeg river, between Lake of the Woods and English river. The ore is reported to be magnetite but no authentic data are available.

Reference:—
Report of the Ontario Royal Commission 1890, p. 64.

Lake St. Joseph Area.

In an area of Keewatin rocks at the west end of Lake St. Joseph there are several outcrops of iron formation. Magnetic readings indicate that the range extends through *Pewabic* and *Quigly islands* for a distance of over five miles. No ore of commercial value was seen.

Reference:—
W. H. Tuckett for R. H. Flaherty, Port Arthur, Ontario, 1912.

Lake Minnitaki Area.

On the south side of Lake Minnitaki, about 12 miles southwest of Lake Superior Junction, are located the *Louis Lac Seul* and the *Helen iron ranges*. The iron formation is composed of alternating bands of siliceous magnetite, jasper and spotted schist, and lies between walls of green schist. The deposit is of too low grade to meet present furnace requirements.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1909.

Eagle Lake Area.

Claims have been staked for iron in the neighbourhood of *Detour point* and on *Net and North Twin islands*. On Net island, where narrow bodies of ore of fairly good quality are exposed, exploration by stripping, shaft sinking and diamond drilling has failed to disclose any quantity of ore deserving of consideration. At depth the principal vein was found to be made up of pyrite with small amounts of chalcopyrite.

References:—
A. L. Parsons, Ontario Bureau of Mines, 1912, p. 184.
W. W. Benner for R. H. Flaherty, Port Arthur, Ontario. 1910.

Dryden Area.

Outcrops of banded iron formation have been found on both sides of the Wabigoon river near *Dryden station* on the Canadian Pacific railway. The iron formation is also fairly well displayed on the railway just east of mile 216, on lot 23, concession IV, of the township of Zealand. Here the granular silica, banded with magnetite, is interbedded with grey gneiss or mica schist, the widest belt of silica and magnetite being about ten feet across. The strike is about N. 50° E. and the dip 80° to the northwest; but the bands are a good deal contorted, and the schists are penetrated by some dikes of granite.

A stretch of drift hides the range for some distance to the east, but it is found again north of *Barclay siding*. Here, about three-quarters of a mile north of the railway, at the corner between lots 16 and 17 in the fifth concession and the corresponding lots in the sixth, siliceous rock banded with magnetite is found, sometimes interbedded with schist or gneiss, having a strike of about N. 80° W.

At Barker's farm on the west side of Thunder lake the iron range crops out again as crumpled masses, sometimes very rich in magnetite, but often containing a considerable amount of silica and hornblende. So far no ore of workable quality has been disclosed. The total distance within which outcrops of iron formation have been found is about nine miles. The width of the iron formation ranges from 100 to 200 feet in places. The average iron content of the formation is estimated at about 30 per cent.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 136.
A. L. Parsons, Ontario Bureau of Mines, 1911, p. 194.

Bending Lake Area.

In the vicinity of *Bending lake*, lying 19 miles southwest of Raleigh station on the Canadian Pacific railway, outcrops of iron formation have been located in a belt with a length of about 10 miles. The general strike of the iron formation is N. 45° W., and the dip is from 45°-55° to the southwest. The iron formation is composed of silica interbanded with magnetite, hematite and micaceous schist. The magnetite bands vary in thickness from a fraction of an inch to three feet or more. A little diamond drilling in addition to surface exploration, has been done.

References:—
Geological Survey of Canada, Summary Report, 1891, p. 29 AA.
J. Walsh, Kenora, Ontario, 1914.

The Victoria iron range (located 37 miles north of la Seine station on the Canadian Northern railway, and three miles east of the Fifth Meridian) is probably a part of the Bending Lake range, as the characteristics of the range are about as those enumerated above.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1909.

Keewatin Lake Area.

Keewatin lake lies in the southeastern corner of the District of Kenora, and about 15 miles southwest of English river station on the Canadian Pacific railway. Claims located near this lake by A. McClure, and near *Welsh lake* by Paul Stone, show only greenstone and quartz impregnated with pyrite and chalcopyrite. They are of no value as iron prospects.

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.
W. W. Benner for R. H. Flaherty, Port Arthur, Ontario, 1912.

III. DISTRICT OF PATRICIA.

Lac Seul Area.

Little Shallow lake lies near the headwaters of the English river, about 90 miles northeast of the town of Kenora, and about 15 miles northeast of Lac Seul. On its shores there outcrop several beds of a dark, fine-grained, stratified rock containing a great amount of magnetite and specular iron ore.

Reference:—
D. B. Dowling (Exploration 1893), Ontario Bureau of Mines, 1912, Part II, p. 41.

Lake St. Joseph Area.

On the Albany river at a point about 35 miles below Lake St. Joseph, and $2\frac{1}{2}$ miles below the mouth of the *Etowamami river* a zone of fine-grained banded magnetic iron ore with slaty partings occurs in an area of Keewatin rocks.

Reference:—
Robert Bell (Exploration 1886), Ontario Bureau of Mines, 1912, Part II, p. 65.

Sutton Mill Lakes Area.

At the narrows between the Sutton Mill lakes there are outcrops of nearly horizontal sandstone beds carrying considerable proportions of magnetite and hematite, which simulate the jaspilytes in appearance. The average iron content is probably not in excess of 35 per cent.

Reference:—
D. B. Dowling (Exploration 1901), Ontario Bureau of Mines, 1912, Part II, pp. 151-155.

IV. DISTRICT OF THUNDER BAY.

English River Area.

Bog iron is rather widely distributed around the headwaters of the English river which flows northward from English station located on the Canadian Pacific railway, 115 miles west of Port Arthur. Concentrations of sufficient size to attract attention have been found at the *Little Bear* lakes, about four miles east of Quorn station on the Grand Trunk Pacific railway, at *Greer and Yellow lakes*, about 12 miles west of the Little Bear lakes, and near *Niblock station* on the Canadian Pacific railway, about 20 miles south of the Little Bear lakes. The deposits are so shallow that no large tonnage of ore is available, and they are not considered of economic importance.

Reference:—
E. S. Moore, Ontario Bureau of Mines, 1909, pp. 180–195.

Matawin Iron Range.

This range has a length of 35 to 40 miles extending from Greenwater lake eastward, south of Lake Shebandowan to the Kaministiquia river, and roughly paralleling the Canadian Northern railway. The iron range is not continuous for all this distance but forms a series of detached areas or lenses of various sizes, which generally have an east and west trend, and an almost vertical dip. The intervals between the various areas of iron formation vary considerably, and in places have a length of several miles.

The iron formation consists of jasper and other closely related siliceous material interbanded with magnetite usually, and occasionally with hematite. The range is geographically separable into three areas, the western or Greenwater lake area, the central or Shabaqua area, and the eastern or Conmee area, which will be described in the order mentioned.

GREENWATER LAKE AREA OF MATAWIN IRON RANGE.

Mining Locations R 526-530 inclusive.

These lie on the east shore of Greenwater lake, and are about 8 miles south of Kashaboiwe station on the Canadian Northern railway which is located about 82 miles west of Port Arthur. Iron formation bands extend for considerable distances through these locations. The width of the bands is in some cases as much as 48 feet. The formation is composed of fine-grained magnetite interbanded with schists. The quantity of iron formation on the property is in all probability large, but the average iron content is low.

At *Long Point lake*, east of Greenwater lake, dark-green serpentine is found associated with magnetite.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1895, p. 81.

SHABAQUA AREA OF MATAWIN IRON RANGE.

The portion of the Matawin iron range which has so far attracted most attention is that in the vicinity of Shabaqua station on the Canadian Northern railway (about 53 miles west of Port Arthur), where a large number of claims have been staked on both sides of the Matawin and Shebandowan rivers. One group of mining locations, W 211-228 inclusive, covers the most promising looking part of the range, and covers an area measuring one mile wide from north to south, and about seven miles from east to west. The iron range in this area will be described in detail commencing at the east. (See map No. 416).

Mining Location W 211 is the most easterly one on which exploration work has been done. In 1892 a shaft was sunk here on a bed of jasper associated with some bands of high grade magnetite. The iron formation occurs in chlorite schist and has been traced for a distance of about 495 feet with a width of 95 feet at the west and 49 feet at the east end. It consists chiefly of jasper and is considered to be of little economic importance.

Mining Location W 212 adjoins W 211 to the west. At the south-eastern end of this claim iron formation is exposed by a stripping 66 × 30 feet.

An average sample of the iron formation gave the following analysis:—

Iron	27·10	per cent
Silica	50·10	"
Sulphur	0·08	"
Phosphorus	0·16	"

Mining Location W 213 joins the last mentioned location to the west. As yet no exposure of iron formation has been found on it.

Mining Location W 214 is west of W 213. In the middle of this location an outcrop of very siliceous iron formation is exposed, 309 feet in length and 213 feet in width.

Mining Location W 215 is situated due west of W 214. On this claim the iron formation has been traced by dip needle readings for nearly 1,800 feet. A stripping in the middle of the claim shows it to be 73 feet wide at that point. An average sample of the iron formation taken from this place gave the following analysis:—

Iron	30·6	per cent.
Silica	47·8	„
Sulphur	0·04	„
Phosphorus	0·11	„

South of this deposit another deposit has been traced by dip needle westward towards the adjoining claim. It has been exposed by a stripping in one place and shows a width of 55 feet. (See map No. 416).

Reference:—
F. Hille, Mines Branch, Ottawa, Publication No. 22.

Mining Location W 216 is situated on the south side of Matawin river where the Shebandowan river flows into it. The Canadian Northern railway traverses nearly the whole north part of the location.

The iron formation is well exposed on a hill about one-quarter of a mile south of the railway track and about 800 feet west of the eastern boundary of the claim. It consists of a fine-grained bluish-grey siliceous slate through which exceedingly fine crystals of magnetite, hardly visible to the naked eye, are disseminated. The average iron content of the formation is very low. Two samples taken at the east and west ends of the exposure and representing widths of 57 and 35 feet respectively gave the following analyses:—

	No. 1	No. 2
Iron	20·99 per cent.	20·90 per cent.
Silica	61·26 „	63·04 „

Going westward several other, though smaller, exposures of iron formation can be seen on this claim. The iron-bearing series is, however, of even a leaner character than that previously described and may more appropriately be classed as ferruginous slate. Sufficient magnetite is present in the rock to enable it to be traced across the claim by magnetic readings, but from an economic point of view the occurrence is of no importance. (See map No. 416).

Mining Location W 217 is situated due west of W 216. It is heavily drift covered and no outcrops of the iron-bearing series are visible, but by magnetometric readings the band of iron formation can be traced across the whole width of the claim, i.e., about half a mile. (See map No. 416).

Mining Location W 218 is due west of W 217, and is one mile long and half a mile wide. The iron formation is prominently exposed near the western boundary line of the claim on a big cliff rising about 25 feet above the surrounding country, and having an elevation of 1,450 feet above sea level. The character of the iron formation is similar to that previously described, though its iron content seems to be somewhat higher as shown by the following analysis representing an average sample taken across an outcrop 47 feet wide near the cliff.

Iron	29·49 per cent.
Silica	52·14 „

Another sample taken about 500 feet farther east and representing an outcrop 17 feet wide gave the following analysis:—

Iron	30·25 per cent.
Silica	51·25 „

Judging from the magnetometric readings and a few outcrops the iron-bearing formation can be traced across the whole width of the claim, reaching its maximum width of 300 feet about 700 feet east of the western boundary line of the claim. (See map No. 416).

Mining Location W 219 adjoins W 218 to the west. It is one mile long and half a mile wide and is divided in two parts by the Matawin river. The iron-bearing formation can be traced by magnetic readings from the eastern boundary line of the claim westward to the Matawin river, a distance of 1,200 feet. It is well exposed in a ravine south of the old camps, and yet more prominently along two small knolls farther west near the river. The iron formation is leaner than that of the previous claim described. Four samples taken at various points across the formation and representing widths of 47, 75, 52 and 33 feet respectively gave the following analyses:—

	No. 1	No. 2	No. 3	No.4
Iron	13·38%	24·28%	17·31%	17·81%
Silica	70·03%	58·78%	66·70%	65·05%

For a distance of about 1,700 feet west of the Matawin river the magnetometric survey gives no indication of any continuous iron formation and a few very small scattered magnetic areas are all that can be found on this part of the claim. (See map No. 416).

Mining Locations W 220, W 221 and W 222.

About 350 feet west of the boundary line between W 219 and W 220 the magnetic attraction comes in again and hence westward the iron formation can be traced by outcrops and magnetic readings, with the exception of one or two small intervals through claims W 220, W 221 and W 222, a distance of 7,000 feet. Judging from the magnetometric survey the width of the iron-bearing formation on claim W 220 may be roughly estimated at 50 to 200 feet. It increases, however, considerably on claim W 221 and reaches a width of over 1,000 feet near the boundary line between W 221 and W 222. Going farther west on W 222 the iron formation decreases again in width, being 100 to 400 feet wide. (See map No. 416.)

On claims W 221 and W 222 the iron formation consists chiefly of a fine-grained siliceous hematite interbanded with siliceous material, black and red chert. Judging from the magnetic character of the formation magnetite is also present. Four samples taken across the exposed formation at various points gave the following analyses:—

	No. 1	No. 2.	No. 3.	No.4.
Iron.........	25·07%	29·35%	30·89%	27·86%
Silica........	54·20%	48·76%	46·34%	49·44%

The widths of the exposures from which the samples were taken were 100, 35, 36 and 47 feet respectively. Samples Nos. 1 and 2 are from claim W 221, 3 and 4 from W 222.

From what has been said in regard to the extent of the iron formation on Locations W 216–222 inclusive, it is evident that a large quantity of low grade iron formation is available, all of which, however, requires fine crushing and concentration with subsequent briquetting or nodulizing before it can be made marketable. To carry on such an operation profitably at the present time does not seem feasible owing to the low iron content of the ore and the extreme fineness to which the grinding would have to be carried before a satisfactory separation could be obtained. The iron formation of the western claims W 221 and W 222 offers also another objectionable feature for magnetic separation on account of the iron-bearing mineral being present there chiefly in the form of hematite.

Reference:—
E. Lindeman, Mines Branch, Summary Report, 1914.

About half a mile north of Matawin river there is another deposit on *Mining Locations R. 476 and R. 484*. It commences at the eastern part of R. 476 and extends through this location into the adjoining one, a distance of about 3,000 feet. Magnetic dip needle readings show a very high average for over 132 feet across this deposit.

It differs somewhat in character from those previously described. Here the magnetite is not so intimately mixed with the silica, but forms separate bands of various size which are interbanded with jasper.

An average sample of this ore gave:—

Iron..............................	51·48	per cent.
Silica............................	25·95	"
Phosphorus........................	0·25	"
Sulphur...........................	0·04	"

About nine chains north of this deposit the dip needle indicates the presence of another ore body, the extent of which has not been ascertained.

Reference:—
F. Hille, Mines Branch, Ottawa, Publication No. 22.

On *Mining Locations R 412, 479, 480, 483, 490, 499, 509, and 511* there occur outcrops of iron formation composed of jasper or chert interbanded with magnetite and hematite. The deposits do not appear attractive enough to warrant exploration.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1907.

On *Mining Locations W 232, 233, 234, 236, 237, 238, 239, 241, 242, 243, 244, and H.P. 673* there are belts of iron formation composed of banded jasper, magnetite, hematite, and iron-bearing slates.

Reference:—
R. H. Flaherty, Port Arthur, Ontario, 1909.

On *Claim T. B. 910* and some others near it there are outcrops of iron formation composed of jasper or granular silica, interbanded with magnetite. The magnetite appears to be of good quality, and occurs in bands clearly separated from the gangue, and frequently with a thickness of from two to three inches. The ease with which a good magnetic concentrate could be secured, and the possibility of finding large tonnage has made this appear as an interesting concentrating proposition.

References:—
G. L. Michael for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
R. H. Flaherty, Port Arthur, Ontario, 1909.
W. W. Benner for R. H. Flaherty, Port Arthur, Ontario, 1910.
W. H. Tuckett for R. H. Flaherty, Port Arthur, Ontario, 1910.

On *Location R 492* the iron formation appears to carry only 20 to 25 per cent magnetite, and the magnetite is lean-looking and occurs in bands less than two inches thick.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ont., 1910.

CONMEE AREA OF THE MATAWIN IRON RANGE.

Scattered through the township of Conmee from concessions I to VIII, and in the unsurveyed territory to the west, and in the townships of Ware and Oliver to the east, there are numerous outcrops of iron formation, the whole group being regarded as the eastern end of the Matawin iron range.

The siliceous ingredient of the iron formation is nearly everywhere jasper, and with this is interbanded both hematite and magnetite. The hematite and magnetite bands vary in thickness usually from a mere film to two or three inches; but at some occurrences a thickness in excess of 12 inches is reported, as in *Lot 4, Con. III, Conmee township*, and on *Kaministiquia mountain in Location R 333* in Ware township, the latter of which has attracted some interest as a possible concentrating proposition.

In a portion of this area the boundaries of the iron formation have been approximately outlined by magnetometric survey (see maps Nos. 409 and 410). A number of average samples, taken across the outcrops shown on the map, show an iron content ranging from 16 to 35 per cent, with silica from 50 to 70 per cent.

While few outcrops of iron formation in this area seem to have been left unstaked, the showings seem not to have been attractive enough to lead to extensive exploration. A few of the properties which have attracted attention (in addition to the two mentioned above) are *Mining Locations* H VIII, R 342, R 393, R 394, and R 411, near Mokomon, showing lean interbanded jasper and magnetite, the *Muirhead Claims*, just west of the above, where there is a band of iron formation with a width of 450 feet, an average sample from across which assayed 34·10% in iron, and 49·00% in silica, the *Montgomery and Strathy Claims* in Concessions I and II, *Mining Locations B. J. 128, 129 and 130*, and the *Pumpelly-Smyth* holdings.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 129–130.
Private Reports for R. H. Flaherty, Port Arthur, Ontario.
Private Reports for Lake Superior Corporation, Sault Ste. Marie, Ontario.
A. H. A. Robinson, Mines Branch, Summary Report, 1915, p. 35.

Gunflint-Whitefish Lake Area.

Under the above title is included the territory adjacent to the North Lake branch of the Canadian Northern railway (formerly the Port Arthur, Duluth and Western railway) from Gunflint lake on the international boundary easterly approximately 35 miles to Whitefish lake.

In this area numerous locations have been taken up for iron ore. The ore occurring on most of these locations consists of thin layers of magnetite or hematite, interbanded with cherts of the Animikie series, but as yet no deposit of sufficient size to warrant exploitation has been found.

Reference:—
E. Lindeman, Mines Branch, Summary Report, 1908, p. 52.

Loon Lake Area.

The Loon lake iron-bearing area lies about 26 miles east of Port Arthur, and is traversed by the main line of the Canadian Pacific railway. Four definite horizons are present in the iron-bearing formation:—

1. The upper black slate.
2. An upper iron-bearing member.
3. An interbedded black slate.
4. A lower iron-bearing member.

The two iron-bearing horizons are themselves quite different in character. The original rock of the upper horizon is a rather thin-bedded cherty dark grey to very light-coloured iron carbonate. A common phase of this horizon is a banded rock composed of alternating layers of iron oxide or partially altered carbonate and light or dark coloured or red iron-stained chert. All stages of gradation can, however, be observed from the original unaltered cherty carbonate rock through the ferruginous cherts and slates to iron ore. At the base the upper iron-bearing formation grades into the underlying slate.

The lower iron-bearing horizon can, except where extremely altered, be readily distinguished from the upper by the constant presence in it of small granules which are entirely absent from the upper horizon. Chemically these granules are essentially hydrous ferrous silicate. Very frequently however, the matrix, surrounding the granules is largely carbonate material which varies from exceedingly fine to very coarse-grained. Associated with the granule-bearing rock of the lower horizon and, in part at least, secondary to it, are phases which show varying degrees of alteration to or replacement by iron oxide. Of the rocks of the formation which contain a high enough percentage of iron to be classed as ore, two phases are characteristic. One is a fine-grained red and blue hematite of medium hardness. The other is one whose texture is that of a medium to coarse-grained carbonate rock, but with the red colour of hematite. That in this latter variety iron carbonate and iron oxide are both present is shown by chemical analysis of certain samples which give higher percentages of iron than is contained in iron carbonate.

The localities in which the greatest concentration of iron has as yet been proven are included in the area extending four miles west, two miles south and one mile east of Loon lake station. The properties on which exploratory work has been carried on are known as the *Flaherty-Knobel*, *Marks-Wiley* and *McConnell properties*. In these areas numerous diamond drill holes have been put down and a considerable amount of trenching and test pitting has been done in search for iron ore. The result of the work thus far done shows that over the greater part of the area the lower iron horizon has been extensively altered to iron oxide, but that, associated with the layers showing the greatest concentration, a considerable amount of lean siliceous material is present either as lenses in the hematite or as layers interbedded with it. Thus the average sample of any considerable vertical section is of low grade. The following analyses are representative of the grade of ore occurring here:—

	1	2	3	4
Iron.........	26·51%	31·24%	40·20%	19·68%
Silica........	34·78%	30·86%	44·76%	61·04%
Sulphur.....	0·06%	0·06%	0·04%	0·13%
Phosphorus..	0·04%	0·08%	0·06%	0·06%

A diamond drill hole penetrating the ore-bearing strata in reaching a depth of 45 feet, cut two bands of ore with thicknesses of 6½ feet and 1¾ feet respectively, three bands of lean ore with thicknesses varying from 3 to 5 feet, and three bands of ferruginous chert with thicknesses varying from 6 inches to 3 feet. This is about typical of the results secured from many drill holes.

These properties have been examined by several engineers, all of whom apparently are agreed that the mining of ore from them would be essentially a sorting proposition.

References:—
W. N. Smith, Ontario Bureau of Mines, 1905, p. 254.
L. P. Silver, Ontario Bureau of Mines, 1906, p. 156.
R. W. Seelye for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1906.
Private Reports for T. J. Drummond, Montreal, Quebec.

Dominion Bessemer Ore Company Property.

About four miles to the southwest of the above described area, lies *Mining Location No. 5*, in the township of Macgregor, which was operated in 1909 by the Dominion Bessemer Ore Company and from which two cargoes of ore were shipped before the close of navigation. An ore loading dock was built and a tramway from the dock to the ore-body about one mile inland. Operations ceased at the end of the year and were not resumed.

Reference:—
Ontario Bureau of Mines, Vol. XIX (1909), p. 81.

Dog Lake Area.

About 25 miles northeast of Dog lake, and about 50 miles due north of Port Arthur lies Little Pine lake. Immediately to the west of *Little Pine lake* a group of 20 claims (T. B. 2020–2039) have been staked for iron, and about four miles to the northwest of the lake another group of 27 claims (T. B. 1731–1757) have been taken up for iron. From the best information obtainable it appears that the iron showings in this locality consist of bands of iron formation composed of interbanded jasper, magnetite and hematite, similar to that occurring in many other parts of Thunder Bay district.

Reference:—
B. Stuart McKenzie, Winnipeg, Man., 1914.

Black Sturgeon Area.

A number of iron locations were taken up years ago southwest of Lake Nipigon on the *southeast side of Black Sturgeon lake*, to the *east of Black Sturgeon river*, to the *east of Nonwatin lake*, and to the *west of Fraser lake*. Slight seams of hematite associated with grey schist and jasper can be seen on some of these locations, but as yet no ore-body of economic importance has been found.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1909, pp., 170–172.

Lake Savant Iron Range.

Lake Savant is about 20 miles northwest of Bucke station on the National Transcontinental railway. West of this lake banded iron formation has a wide distribution. Beginning on the west shore of the lake it extends more or less continuously westward for about 25 miles, reaching beyond the southern end of Cliff lake. South of the eastern portion of *Lake Kashaweogama* (10 miles west of Savant lake) the range becomes more concentrated, and the most important portion of it occurs in this vicinity. The range is here about one mile wide, with a band about a quarter-mile wide fairly free from country rock. South of the main band there are a number of parallel narrow bands of no economic interest.

Part of the western portion of the range is composed almost entirely of banded quartz and actinolite, but generally the iron formation consists of banded red jasper and magnetite and quartz in the form of interlocking crystals developed by the crystallization of chert. The bands in the jasper vary in width from microscopic size to a quarter-inch or even an inch in width. This banded jasper is again interbanded with wide and narrow bands of greywacke, hornblende schist and a grey, fine-grained gneiss. By far the most common rock occurring with the red jasper and magnetite is greywacke, and the bands of jasper and greywacke vary greatly in width. In places there is as much as 50 feet of almost pure red jasper and magnetite, while in others these minerals occur as bands only an inch or two wide in large masses of schist or greywacke.

Two picked specimen of iron formation gave the following analyses:—

	1.	2.
Iron	33·36 per cent.	43·82 per cent.
Silica	50·20 „	39·00 „

There has been a good deal of test-pitting and stripping, and one or two shafts have been sunk 15 or 20 feet, but no drilling has been done, and so far nothing which can be regarded as "pay ore" has been located. The greater portion of the iron formation, even where free from schist, does not carry more than from 30 to 35 per cent of iron.

The only portion of the range which may be of some economic interest is the widest belt south of Lake Kashaweogama. The length of this belt is about three miles with a maximum width of ¼ of a mile.

References:—
E. S. Moore, Ontario Bureau of Mines, 1910, pp. 186–187.
R. H. Flaherty, Port Arthur, Ontario, 1910.

Round Lake Area (North of Lake Nipigon).

Round lake is an expansion of the Mud river, and lies about twenty-seven miles up the stream and directly north of Windigo bay on Lake Nipigon. About one-third of a mile north of Round lake some narrow bands of lean iron formation occur in a chloritic or grey gneissic schist.

The length of the range is about one mile, and its width is very indefinite. It shows only in a few places where it outcrops through drift, which is very heavy in this region. Bands of magnetite, hematite and silica, from eight inches to as many feet in width, occur, but they gradually grade into a fine-grained grey gneiss or into schist containing much silica and chlorite and in some cases stained with oxidized pyrite. The range is considered to be of little economic importance.

A narrow band of iron formation exposed on *Caribou lake*, 16 miles to the northwest, is possibly a continuation of the Round Lake band.

At *Haystack mountain* close to the National Transcontinental railway, and about 10 miles southeast of Round lake, a number of claims have been staked for iron. Investigation showed that the area included in this staking is underlain exclusively by Keweenawan diabase, and that the iron ore present is ilmenite or titaniferous magnetite, occurring in small segregations throughout the diabase, a mode of occurrence giving no promise of tonnage.

Reference:—
E. S. Moore, Ontario Bureau of Mines, 1909, pp. 158–162.

Onaman Iron Ranges.

The Onaman iron ranges lie northeast of Lake Nipigon, and surround the head waters of the *Red Paint* river. They extend nearly east and west and are about two miles apart. The *Northern range* beginning below *Holliday lake*, extends across the height of land and along Johnson creek a distance of almost 10 miles. It is traversed by the National Transcontinental railway. The range is not represented by continuous outcrops, the gaps being of considerable extent. The outcrops, are, however, sufficiently close together and the local magnetic attraction, where outcrops do not occur on account of the thick coating of drift, is sufficiently strong to warrant one in regarding this as a continuous band. The width of the range varies greatly. At the western end the range is represented by a few feet of very lean iron formation, but near the *Maple Leaf claims* it widens to nearly half a mile. At this point the area is not, however, occupied by continuous iron formation, but only by narrow outcrops appearing in green schist, tuff, or rhyolite. Where the range crosses the *Height of Land claims* the formation is continuous over a width of 150 yards, but contains a good deal of greywacke and slate; and some rhyolite and green schist have been folded into it. The outcrop at the divide disappears under the drift and re-appears again on the *Winter Camp claims*, two miles to the east where the formation occurs as narrow outcrops on either side of a mass of greenstone which has been faulted into it. The formation is again hidden under the drift and three miles to the east re-appears as a considerable outcrop in the vicinity of the *Miller claims*. Although the range here is broken up by the older rocks near the surface and the formation is excluded from view by the drift which covers portions of this area to a depth of 100 feet or more, sufficient outcrops occur to show that the range can be traced over an area of two miles long by $1\frac{1}{4}$ miles wide. The formation here is, on the whole, pretty lean, there being much slate and schist with the jasper.

Exploratory work on some of the most promising looking claims on the northern range was performed in 1906 and 1907 for R. H. Flaherty

The following information as to results of this exploration have been furnished.

On the *Height of Land claims* an average sample of an outcrop 2,600 feet long, with a width in one place of 305 feet, ran as follows:—

Iron	40·49 per cent.
Phosphorus	0·065 „

A diamond drill hole 254 feet deep on the Winter Camp claims cut ferruginous schist, and jasper carrying magnetic ore, and a surface outcrop 30 feet wide furnished a sample assaying as follows:—

Iron	37·92 per cent.
Phosphorus	0·042 „

On the *Miller claims* a diamond drill hole 143 feet deep cut ferruginous schist, banded jasper and magnetite and greenstone. A stripping 50 feet × 650 feet gave a sample of the following analysis:—

Iron	43·48 per cent.
Silica	35·90 „
Sulphur	Trace
Phosphorus	0·045 „

The Northern range contains a large amount of banded jasper, but scarcely any sign of concentration of iron ores has been found.

The *Southern range* is somewhat more continuous and compact than the Northern. The most westerly outcrop lies along the south side of *Castor lake*, where a very narrow band of jasper occurs. There is then a break where drift extends for a mile between this small outcrop and the main portion of the range. It is quite probable that the formation underlies the drift. The main portion of the range is represented by almost continuous outcrops for a distance of two miles, with a maximum width of 700 feet. This range, like the northern one, also contains a good deal of foreign rock in its widest areas. At the east end of the southern range the iron formation runs under drift, but local deflections of the compass in a large swamp and the occurrence of a very small outcrop of iron formation a mile and a quarter east of the main range, show that the range is continuous for at least a mile and a half under the swamp.

On the southern range there are wider and longer bands of magnetite than on the northern range. A sample of one of the better looking bands a few inches wide and several rods long gave the following analysis:—

Iron	50·82 per cent
Silica	26·85 „

One of the richest looking outcrops (with a width of 15 feet) was sampled with the following results:—

Iron	55·79 per cent.
Silica	37·10 „

There are many bands of banded jasper and magnetite a few feet wide similar to one, a sample from which gave the following analysis:—

Iron	38·83 per cent.
Silica	50·00 „

The iron formation of the Onaman ranges includes ferruginous cherts, slates, phyllites, greywackes, actinolite-magnetite-schists and jaspers. The relations between the rocks of this formation are such that a band of jasper half an inch in width may occur between bands of slate and greywacke 20 feet in width, and on the other hand almost clear jasper bands may reach a maximum of nearly 50 feet. Some of the narrow bands of ferruginous cherts may contain a large percentage of iron, as, for example, one band a few inches wide from the southern range, which was analysed and found to contain 50 per cent of metallic iron and 23 per cent of silica, but from information given above, it is seen that neither range has been shown to contain ore which can be worked under present conditions.

References:—

E. S. Moore, Ontario Bureau of Mines, 1909, pp. 196–253.
R. H. Flaherty, Port Arthur, Ontario, 1908.

Iron Ranges East of Lake Nipigon.

East of Lake Nipigon in the vicinity of *Poplar Lodge*, an abandoned Hudson's Bay post, there are three iron ranges known locally as the Northern, Central and Southern ranges. A few miles east of these, and a little to the north there are additional outcrops of iron formation near Windegokan, Still and Watson lakes. This territory is now easily accessible by the main line of the Canadian Northern railway which lies not more than three miles to the south of the iron ranges. The distance to Nipigon village on Lake Superior is between 60 and 70 miles.

The *Northern range* has a length of about a mile and a quarter, running northeastwards through Locations A. L. 408, 407, 406, 405, 404, 403, 402, near the north bank of Sturgeon river two or three miles from its mouth. It is seldom more than fifty feet wide, but reaches a width of 240 feet, with intermixed slaty rock at one spot on A. L. 403. In general the banded silica lies just to the southeast of a ridge of greenstone, under which it dips at an angle of 35 to 60 degrees. On the opposite side the iron formation generally runs under old lake deposits towards the river bank.

Both magnetite and hematite occur, though the latter shows red only when powdered. The silica bands are generally cherty or quartzitic.

with occasional strips of dull jasper. On the whole the range is too narrow and lean from the admixture of silica and slate to be very promising.

The *Central range* is three miles south of the northern, and is first seen a mile and a half inland from Poplar Lodge. This part of the region is mostly covered with sand plains and swamp, so that solid rock does not crop out very frequently and then only as low rounded surfaces, making it difficult to prospect without doing much stripping. A considerable amount of work has been done in this way, and three diamond drill holes have been sunk on the most important outcrop, but undoubtedly much of the range still remains covered. The known outcrops are in four localities, (1) A. L. 414, (2) at the north end of A. L. 413 and 412, (3) in A. L. 416 and adjacent portions of A. L. 413 and H. F. 1, and (4) in H. F. 5. The third area is the most attractive and has been most thoroughly prospected, showing a widespread series of bands of iron formation over a length from east to west of half a mile and a breadth of a quarter of a mile. Including all four outcrops the range has a length of nearly three miles, with a breadth of about three-quarters of a mile where widest, but these limits include much drift-covered surface and barren rock, and the most easterly outcrop is separated from the others by a mile and a half in which no iron formation has been found.

The ore is entirely hematite and the associated silica is jasper, often bright red. In the areas mapped as iron range more than one-half consists of grey and green schist in which fragments and long strips of the iron formation are imbedded and in general the jaspery strips tend to run out into schists towards the east and west. A narrow belt of Huronian conglomerate runs parallel to several of the outcrops, and is occasionally repeated several times as in Location A. L. 414. This seems to indicate a number of small parallel folds of the structure, so that the great width of this range is probably due to repetition. In one place on the boundary between A. L. 413 and 416 a diamond drill hole showed jasper and ore 414 feet below the surface, so that the synclines are not shallow.

In general it may be said that in the iron formation there is a considerable amount of lean ore but generally in narrow bands and lenses separated by several feet of jasper and schist.

Three samples of ore taken by Prof. Coleman gave the following analyses:—

	1.	2.	3.
Metallic iron.......	44·2%	37·4%	40·0%

A specimen of hard, blue hematite from a surface lens is reported to have run 64·42 per cent in iron. This was probably a carefully selected specimen since the average iron content of 33½ feet of ore encountered in drilling was estimated by the late A. B. Willmott to run between 40 and 50 per cent.

The *Southern range* has a length of seven miles, including interruptions of drift and barren rock, and a maximum width of 500 feet, though the average width is not more than 50 feet. It is separated from the nearest point of the central range by three-quarters of a mile of greenstone and schist rising as a ridge. The Southern range contains a good deal of magnetite as well as hematite and some jasper. It resembles the Northern range, though much more extensive and also richer in iron. The associated rocks are slate and grey and green schists, and the range fades out laterally into the other rocks. The arrangement is unsymmetrical, the richest and most magnetic ore generally occurring on the north side of the range, while leaner bands are interbedded with slate or schist to the south. The general direction of the range is north of east, following the usual strike of the region, and the dip like that of the Central range is high, from 60 degrees to vertical.

Five samples of ore from the Southern range gave the following analyses:—

	1.	2.	3.	4.	5.
Metallic iron.......	38·06%	30·06%	37·19%	37·79%	34·02%
Silica..............	40·6%				
Sulphur...........	Trace				
Phosphorus........	„				
Titanium..........	None				

No. 1 was a sample of the best looking ore obtainable. No. 2 was an average sample of formation over a width of 82 feet; and Nos. 3, 4, and 5 were average samples excluding the leaner part of the outcrop.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1907, pp. 115–128.
A. P. Coleman, Ontario Bureau of Mines, 1908, pp. 146–147.

Lying in Mining Locations H. F. 13, 12 and 10, just west of *Windegokan lake*, there is a mass of iron range of considerable proportions. It is composed of grey slate and jasper interbanded with hematite. Two samples of the richest looking part of the iron formation show only 35·75 and 36·56 per cent of iron respectively. Much of the mass lies under swamp and drift, and although the drift has been partly removed by trenching it is impossible to say what lies under the swamp. Nothing was seen to justify the assumption that a large ore-body exists. There is much schist in some of the range, the dip is about 90°, and there seem to be no particular geological conditions to cause a concentration of ore at this place. This outcrop becomes greatly mixed with schist before running into the eruptive sheet to the west, and also at the east end before disappearing under the drift. Just south of this outcrop and in Location H. F. 11 is a small mass of jasper and banded magnetite.

In Mining Location B. T. O. 1 on the south shore of *Still lake* there is an occurrence of iron formation of considerable size. A large portion of this is excluded from view by drift and swamp, but it evidently extends from Still lake to White Fish lake, a distance of about half a mile. Although at either end the range is not more than about 15 feet wide it widens out in the centre to about 450 feet. Towards the east end it dips under the water of Still lake.

The iron formation is composed of silica, with a little hematite, and with it is intermixed much schist. The best sample taken had an iron content of 36·86 per cent, which is much too low for a merchantable iron ore; and there is no indication of any secondary concentration.

About 1½ miles south of Still lake a band of iron formation outcrops at the northeast end of *Watson lake.* This extends easterly through Locations H. F. 32, 35, 39 and 40, a distance of about 2 miles. Its greatest width is about 100 feet. The formation consists of jasper and magnetite, and it is bounded on the north and south by slaty green schist. The richest specimen of magnetite collected from it ran 48·9 per cent in iron.

For 6 or 7 miles farther eastward unimportant outcrops of iron formation occur at widely separated intervals, the chief of which are those in Locations H. F. 37 and 38 near *Lake Nora*, those in Locations H. F. 45 and 46 southeast of Lake Pasha, and those to the north of *Lake Nissiamkeekam.*

Still farther to the east a few claims have been staked near the headwaters of the *Black river* on showings of iron formation (not more than six feet wide) composed of banded sugary silica with a little magnetite.

References:—
E. S. Moore, Ontario Bureau of Mines, 1907, pp. 144 and 145.
A. P. Coleman, Ontario Bureau of Mines, 1908, pp. 148–154.

Little Long Lake Area.

Little Long lake lies about 55 miles north of Jackfish station on the Canadian Pacific railway, and about the same distance east of Lake Nipigon. It is now easily reached by the Canadian Northern railway which skirts its northern shore, the distance to Nipigon village on Lake Superior being about 115 miles.

The first suggestion of iron formation is found on the south side of the western end of the lake in Location A. L. 439, where a few thin seams of banded grey and black material of very low grade occur in a green schist. The largest outcrop of iron formation is at the east end of a large island in *Mining Location A. L. 431* where stripping discloses a width of 24 yards of iron formation intermixed with schists. Another stripping a short distance west shows 40 yards of surface made up of very lean iron formation without schist and containing some dull red jasper. The chief iron mineral here is hematite. The greatest width of the banded iron formation found on the island is 130 yards and the total length of the outcrop is a little over a quarter of a mile. West of the lake several locations have been taken up. Several bands of iron formation mostly very lean, have been found on these claims, and fairly strong local magnetic attraction occurs in several places.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1909, pp. 146–148.

Jackfish Area.

About $1\frac{1}{4}$ miles north of Jackfish station and close to the Canadian Pacific railway track, are located the workings on Location A. L. 388 of the *Argenteuil Mining Company*. The development undertaken between 1900 and 1903 consisted of two shallow shafts and a tunnel on a narrow seam of hematite.

Reference:—
Ontario Bureau of Mines, Vol. XIII (1903), p. 74.

On the *Slate islands*, eight miles south of Jackfish there are small exposures of banded jasper and chert.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 137.

Little Pic River Area.

On the north shore of Lake Superior near the mouth of the Little Pic river, two locations were taken up many decades ago for iron. It now appears that what attracted attention was the occurrence of a rock (probably hornblende syenite) in which magnetite was present either disseminated in small grains, or segregated in small pockets.

References:—
Peter McKellar, Toronto, Ontario, 1874.
Chas. Robb, Montreal, Quebec.
J. Weatherly, 1873.
T. W. Herrick, Port Arthur, Ontario.

Western Michipicoten Area.

The extreme westerly development of the Michipicoten iron ranges lies in the southeasterly corner of the District of Thunder Bay, and in this locality there are two iron-bearing horizons several miles long, and several occurrences of less interest.

One of the iron-bearing horizons lies just south of the East Branch of the *Pucaswa river*, and extends from the township of Homer to David's lakes, a distance of about eight miles. All the area has been staked as iron claims, the holdings being known as the *Big Dave*, *Knapp*, and *Goetz-Conmee* properties.

Through the Big Dave and Knapp properties there extend two iron-bearing horizons about three miles in length, with a uniform northerly dip of 30° to 40°. The total thickness of these horizons may be 200 feet or more, but the bands of iron formation in these horizons rarely exceed a thickness of 25 feet, being separated by schist, volcanic breccia or porphyrite.

The iron formation is composed of alternating bands of grey and white chert and granular silica, and greyish lean magnetite and good magnetite. The magnetite is usually siliceous and the bands are not clean cut; instead they usually blend away into the purely siliceous bands. Ordinarily there are four or more bands to the inch. The banding is not always conspicuous as the contrast in colour between greyish chert and lean magnetite is not great. The iron content of average samples of iron formation will be always less than 35 per cent.

From the best information obtainable it seems that the iron formation on the *Goetz-Conners* claims is essentially the same, as to mode of occurrence and composition, as that on the Big Dave and Knapp properties.

About four miles southeast of David's lakes, the westerly end of another iron-bearing horizon is picked up at Maple lake. This extends brokenly eastward from *Maple lake* to *Cameron lake*, a distance of about eight miles. The iron formation consists of banded cherts occurring in narrow parallel bands.

Minor occurrences are reported at the mouth of the *Julia river*, near *Pucaswa harbour*, and elsewhere in the township of Homer, at *McDougall lake* eight miles north of the Knapp claims, and near the mouth of *Eagle river*, six miles southeast of Cameron lake.

About 25 miles northeast of the Big Dave and Knapp properties near the headwaters of the East Branch of the Pucaswa river there is an outcrop of iron range west of Iron lake, which has attracted a good deal of interest, but only the lean westerly end of the range between *Bole and Abbie lakes* lies in the District of Thunder Bay.

References:—
J. M. Bell, Ontario Bureau of Mines, 1905, pp. 313–317.
W. W. Benner for R. H. Flaherty, Port Arthur, Ontario, 1910.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1911.
James Conners, Seattle, Washington, U.S.A., 1915.

V. DISTRICT OF ALGOMA.

Michipicoten Area.

Lying mostly within 25–30 miles of the port of Michipicoten harbour on Lake Superior is an area with no fixed boundaries, generally known as Michipicoten. Iron formation rocks outcrop plentifully in this area. Geographically the iron range occurrences fall into three groups, a northern a central and a southern. The area is in part traversed by the Michipicoten Division of the Algoma Central and Hudson Bay railway by which access is had to the city of Sault Ste. Marie (distant about 180 miles from the operating mines) and to Michipicoten harbour on Lake Superior.

Northern Section of Michipicoten Area.

The northern iron-bearing belt stretches approximately east and west for a distance of about 50 miles extending from the headwaters of the East

Branch of the Pucaswa river in the District of Thunder Bay through townships 33, 32, 31, 30, 29, 28, and 27 in range XXVI of Algoma. Through this belt the iron formation appears in bands varying from a few feet to over 1200 feet in width and in length from a few yards to 3 or 4 miles. Several of these occurrences have appeared sufficiently promising to merit very considerable amounts of exploratory work in search of iron ores. The occurrences explored most extensively are the Iron Lake, Frances Mine, Brant Lake, Magpie Mine, Alice, Goudreau and Morrison properties, the two latter for iron pyrites.

Iron Lake Property.—

Iron lake lies in township 33, R. XXVI, Algoma, about 25 miles northwest of Michipicoten harbour. Iron formation here extends from Bole lake on the west to Red Pine point at the eastern end of McDougall's promontory, a distance of 4 miles. Its width ranges from 200 feet to 1,200 feet, and averages more than 1,000 feet for over half a mile. The general strike of the formation is N. 80° E. and it dips south at angles varying from 55°–90°. Quartz-porphyry schist and pinkish, yellowish or greenish felsites are the enclosing rocks. Within the iron formation practically all types of iron formation rocks occur, but the prevailing type is a somewhat impoverished, banded chert, almost always magnetic.

On claims Y 312, Y 313, and Y 315 a considerable amount of stripping was done, much test-pitting carried out, three tunnels driven, and one shaft sunk on small pockets of ore visible on surface. No ore-body of economic interest was found. Pockets of good soft hematite were found here and there in the workings but with the ore was generally mixed a good deal of chert. Four samples of ore encountered in these workings gave the following results on analysis:—

	1	2	3	4
Iron	41·20%	55·10%	48·90%	44·10%
Silica	37·64%	15·02%	24·99%	32·08%
Sulphur	0·022%	0·025%	0·034%	0·020%
Phosphorus	0·015%	0·043%	0·039%	0·026%
Alumina	0·357%	0·126%	0·676%	0·605%
Lime	0·078%	0·070%	0·070%	0·075%
Magnesia	Trace	Trace	Trace	Trace
Manganese	None	Trace	None	None

After an interval of several years exploration was resumed in 1909, five diamond drill holes with an aggregate footage of 3,500 feet being put down, and a considerable amount of trenching done. This work showed only ore-pockets similar to those explored by the tunnels and shaft, i.e., none with greater width than 25 feet and all much mixed with chert. No tonnage of ore of economic interest has been located.

References:—
J. M. Bell, Ontario Bureau of Mines, 1905, pp. 317–327.
Records of Exploration, Lake Superior Corporation, Sault Ste. Marie, Ontario, 1911.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 209.

Frances Mine.—

The Frances Mine iron range is an irregularly shaped hill presenting steep cliffs to the north, northwest, and east. It lies about 20 miles north-northwest of Michipicoten harbour, and about the same distance west of Magpie mine. Banded iron formation consisting of impoverished banded chert, very ferruginous banded chert or jasper, granular pyritous chert, much oxidized sideritic chert, and a few seams of hematite are found along this hill. The total outcrop has a maximum width of 935 feet and a length of 1,375 feet.

Several small and unimportant bodies of iron ore occur on the surface. The ore is generally a rich compact hematite. The value of these small deposits is, however, lessened by numerous small horses of jaspery chert. The larger of these ore-lenses has a length of 40 feet with a maximum width of 9 feet. The following analysis shows the composition of the hematite:—

Iron	62·46	per cent
Sulphur	0·02	„
Phosphorus	0·02	„

Exploration at depth by six diamond drill holes showed only *pockets* of ore similar to those occurring on surface.

References:—
J. M. Bell, Ontario Bureau of Mines, 1905, pp. 328–329.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 208.

Brant Lake Property.—

Brant lake is a small body of water lying about a mile east and a half mile south of the northwest corner of township 30, R. XXVI, Algoma, and about 10 miles northwest of Magpie mine.

About a mile to the northwest of this lake there is a high hill from which diverge in a southeasterly direction several bands of Helen iron formation. Some extend as far as Brant lake, some not so far, and some extend beyond to the east. The iron formation bands consist of rusty, sometimes highly magnetic, banded chert, often soft ore, jasper, sideritic and pyritic chert, rusty quartzitic, and granular silica, amphibolitic schist, and of small bodies of hydrous hematite, and of siliceous magnetite.

These iron formation bands are called the Leach Lake bands in the Ontario Bureau of Mines Report for 1905, but the portion of the range explored is known locally as the *Brant Lake Property*.

Iron formation band No. 3 (of the Ontario Bureau of Mines report) is the one around which the greater part of the exploratory work has centred. This band, east of a prominent dike, which intersects it, has a length of 1,700 feet and a width varying from 250 to 375 feet; to the west of the dike it is narrower and less attractive.

Exploration in 1902 revealed along the north side of Band No. 3, and east of the dike small deposits of siliceous magnetite. Three samples from outcrops within 125 feet of the dike on analysis showed the following range:—

Iron	42·00 –49·00 per cent
Silica	25·00 –39·00 „
Sulphur	0·06 – 0·14 „
Phosphorus	0·015– 0·040 „

About 400 feet farther east there are small outcrops of magnetite of similar character.

Subsequently (in 1911) three diamond drill holes were put down on this iron formation band. No. 1 hole, directed under the principal surface showings at an angle of 45°, cut ore from footage 242 to 297 of the following average analysis:—

Iron	43·14 per cent
Silica	14·00 „
Sulphur	1·544 „
Phosphorus	0·022 „

Drill Hole No. 2 (300 feet east of No. 1) and dipping under surface showings of lean magnetite cut lean ore from footage 161 to 204 of the following analysis:—

Iron	31·54 per cent
Silica	21·05 „
Sulphur	2·825 „
Phosphorus	0·024 „

Drill Hole No. 3 was drilled vertically to cut the ore shown by Hole No. 1 at a depth of 500–600 feet, if it should extend that far. From 500–513 feet the hole cut very lean ore, chiefly siderite, of the following analysis:—

Iron	28·56 per cent
Silica	22·60 „
Sulphur	3·438 „
Phosphorus	0·013 „
Loss on Ignition	8·64 „

The net result of stripping, test-pitting, over 3,000 feet of trenching, and 2,921 feet of diamond drilling is that it is highly improbable that any tonnage of merchantable ore exists on the property.

References:—
J. M. Bell, Ontario Bureau of Mines, 1905, pp. 330–331.
A. Hasselbring for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 208.

Magpie Mine (Mining Claims J. L. 62–69 inclusive, J. L. 74) (See Vol. I.)

Alice Property (Mining Claims J. L. 88, 89, and 90).

The Alice property lies about a mile south of Magpie mine, and is traversed by the Magpie branch of the Michipicoten Division of the Algoma Central and Hudson Bay railway. On Claim J. L. 88 of this property and for a distance of 2,000 feet north along a steep ridge there are numerous lenses of magnetite of various sizes. Some of these show attractive surface outcrops, the samples assaying as high as 54 per cent iron. Nearly all, though, carry disseminations and little patches of iron pyrites. One of these magnetite lenses was proven to have a depth of nearly 600 feet, but others were proven to be shallow.

A considerable amount of surface work and 4,858 feet of diamond drilling was done in an attempt to prove up tonnage of merchantable ore but without success.

Drill Holes Nos. 1 and 2 on one ore-lens cut respectively 50 and 35 feet of pyritic ore. Representative samples of this ore gave the following average analyses:—

	Hole No. 1	Hole No. 2
Iron	35·43 per cent	39·07 per cent
Silica	17·13 „	21·92 „
Sulphur	4·47 „	9·05 „
Phosphorus	0·012 „	0·017 „

Drill Holes Nos. 3, 5, and 6 were drilled on another ore-lens, Nos. 3 and 5 being vertical. No. 3 cut ore pyritic magnetite from 26–300 feet and from 326–586 feet, and No. 5 cut similar ore from 5–127 feet, and from 210–525 feet. Hole No. 6 dipping at 70°, cross-cut the ore-body from footage 262 to 365. Average analyses of the ore cut in these three holes are as follows:—

	Hole No. 3.	Hole No. 5.	Hole No. 6.
Iron	42·57%	38·85%	32·37%
Silica	15·80%	19·47%	20·35%
Sulphur	7·74%	2·29%	4·918%
Phosphorus	0·027%	0·025%	0·023%
Alumina	1·66%	2·50%	4·20%
Lime	5·17%	5·77%	6·22%
Magnesia	3·99%	3·98%	3·49%
Manganese	1·79%	2·20%	1·02%
Loss on Ignition	3·03%	3·90%	5·90%

Reference:—
Records of Exploration, Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.

Besides the occurrences of iron formation just described there are in the same area numerous occurrences not considered of economic interest.

Among these may be mentioned outcrops along *Iron creek*, and *Dog river* between Iron lake and Frances mine, others near *Mount Raymond*, *Morse mountain*, and *Lake Charlotte* to the north of Frances mine, another on *Brotherton hill* to the east of Frances mine, and belts on the north and southeast shores of *Kabenung lake* which converge towards Brant lake.

In the vicinity of Magpie mine there are unimportant outcrops to the northwest of the mine near *Pyrrhotite*, *Godon* and *Pashoskoota lakes*, to the north along both sides of *Evans Creek*, and to the east the *Eccles lake*, and *Gravelle claims*, to the southeast along the east bank of the Magpie river, the *Goodwin range*, and to the west the *Gibson claims*.

A few miles to the west and northwest of Goudreau station on the Algoma Central and Hudson Bay railway, and about 10 miles northeast of Magpie mine there is a series of outcrops of banded grey and black chert and magnetite 3 or 4 miles long, portions of which are known as the *Dreany* and *McKay* properties. Though the areal extent of iron formation rocks here is large there is no sign of concentration on the range.

A mile south of Goudreau station and to the west of the railway on the *Morrison prospect*, there is a fairly persistent band of iron formation in which it is possible deposits of siderite of considerable size may be shown up.

Central Section of Michipicoten Area.

This iron-bearing belt has a length of about 20 miles stretching north-easterly from Little Gros Cap on Lake Superior to township 28, range XXV, Algoma, where its outlying bands seem to merge with outliers of the easterly end of the northern belt. The belt is traversed from end to end by the Michipicoten Division of the Algoma Central and Hudson Bay railway.

The occurrences of iron formation in this belt have attracted a good deal of attention, and very considerable sums of money have been spent in exploring several of them. Those of chief interest are Gros Cap Mining Location, Helen Mine, Johnston Locations, Brooks Lake Claims (Lucy Mine), Ruth Iron Mine (or Long Lake Property), Josephine mine and Bartlett property.

Gros Cap Mining Location.

On the southwest or lakeward side of Little Gros Cap peninsula two excavations over 100 feet long were made and a shaft 64 feet deep sunk on a showing of iron formation. The formation, which has a width of 150 feet, consists of red hematite interbanded with thin layers of chert and granular silica. The thickness of the hematite bands varies from [illegible] to 4 or 5 inches.

Within a short distance two more iron formation bands of no economic interest may be seen.

Outcrops of minor significance are reported from the east side of the location near Little Gros Cap harbour.

References:—
McFarlane, Geological Survey of Canada, Report 1866.
A. B. Willmott, Ontario Bureau of Mines, 1899, p. 145.

Helen Mine (*Hematite Deposits*). (See Vol. I).

Helen Mine (*Siderite Deposits*).—

The Helen Mine Iron range lies near the south side of township 29, range XXIV, in the District of Algoma. On it is located Helen mine connected by a short spur with the Algoma Central and Hudson Bay railway, by which access is had to Michipicoten harbour on Lake Superior, 12 miles distant, and to Sault Ste. Marie, 182 miles distant.

The iron range is $1\frac{3}{4}$ miles in length and for a distance of over three-quarters of a mile from the westerly end, has an average width of 1,200 feet; in the easterly half the width decreases gradually from 1,000 feet to a mere point. The range stands about in the vertical, and strikes a little north of east.

The iron formation is composed chiefly of cherty and granular silica, usually massive, but in places slightly banded. In many places it has been badly crushed, and brecciated. In subordinate amount there occur siderite and hematite, which exploration has shown lie exclusively along the south side of the range. With the chert, granular silica, and siderite, there is usually associated more or less pyrite, even to the extent of deposits of considerable size of marketable grade.

Helen mine was opened up in 1899 on a deposit of brown hematite located at the east end of Boyer lake near the middle of the range. The first shipments of ore were made in 1900 and except for two intervals, each of about 10 months' duration, the mine has operated continuously ever since. At the present time (1915) the ore reserves are nearly exhausted and the tonnage of merchantable ore still available for extraction is indeterminable, but it is probably less than 200,000 tons.

The existence of siderite in the vicinity of the mine has long been known though it was not until 1910 that attention seems to have been focussed on it. One conspicuous showing is exposed in the railway rock-cuts between Boyer and Sayers lakes about 1,700 feet west of the mine. On Mount Hematite, immediately to the east of the mine, and 500 feet above the collar of the shaft the existence of siderite was known from the early days of the mine, but only a meagre amount of work had been done on this showing. Underground development in 1910 and successive years indicated the existence of a considerable tonnage of siderite adjacent to the hematite deposit from the 5th to the 9th levels, i.e., from 375 to 650 feet below the collar of the shaft.

With a view to gaining some additional information concerning the size and character of these deposits surface exploration and diamond drilling were carried on in 1913 and 1914.

Johnston Locations (*Mining Locations 9–14 inclusive*).—

On the Johnston locations about 3 miles east of Helen mine and a short distance south of Eleanor lake there are two bands of iron formation. These are composed of banded siliceous material and lean magnetite and hematite on the north side, and massive, siliceous material on the south side. On each there is found between the banded and the massive silica a lens of siderite.

A few pits were put down in the siliceous portions of the iron formation years ago, but no exploratory work has been done to prove up the siderite deposits.

References:—
A. Hasselbring for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 207.

Brooks Lake Claims (*Lucy Iron Mine*).—

These claims (situated within 2 miles of the Michipicoten Division of the Algoma Central and Hudson Bay railway) include a band of iron formation lying to the north of Brooks lake located 4 miles northeast of Helen mine. The iron formation band is about 2 miles long and its width varies from 150 to 800 feet. It is composed of banded ferruginous chert, often much impoverished, soft granular rusty silica, sideritic chert, and siderite.

Trenching across the range has disclosed three lenses of siderite, one 400 feet long by 30 feet wide, a second 1,800 feet long with a width varying from 30 to 100 feet, and a third 1,200 feet long with a width, in places, of 75 feet. The largest one should yield 1,000,000 tons of siderite with each 100 feet of depth.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 161.
Alois Goetz, Engineering and Mining Journal. Vol. 93, p. 1091.
A. Hasselbring for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
John E. Kelly, Sault Ste. Marie, Michigan, U.S.A., 1915.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 210.

Ruth Iron Mine (*Long Lake Siderite Deposits*).—

The Ruth iron mine is located near the north boundary of township 28, range XXIV, in the District of Algoma. The Michipicoten Division of the Algoma Central and Hudson Bay traverses the property, and the distance over this to Michipicoten harbour on Lake Superior is 21 miles.

The iron formation consists of ferruginous chert, banded and brecciated, granular pyritous chert, and lenses of siderite and pyrite. Trenching, stripping, and a tunnel, located 150 feet beneath the crest of the siderite outcrops, are said to have demonstrated a siderite deposit 2,000 feet long with a maximum width of 200 feet, and a usual width of 100 to 140 feet.

The tonnage above the tunnel level is estimated at 3,000,000 tons (Alois Goetz). The owner reports the siderite to be of the following average analysis:—

Iron	35·00 per cent
Silica	8·00 „
Sulphur	Not determined.
Phosphorus	0·012 per cent.
Lime	5.08 „
Magnesia	6·71 „
Manganese	Not determined.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 173.
Alois Goetz, Engineering and Mining Journal, Vol. 93, p. 1091.
Alois Goetz, Private Communication, 1915, Sault Ste. Marie, Michigan, U.S.A.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 210.

Josephine Mine.—

This property is located at the westerly end of a range of iron formation, 3½ miles long with general east and west strike, and covered in part by the waters of Parks and Kimball lakes, lying in the south part of township 28, range XXV, in the District of Algoma.

A railway spur about ⅓ mile in length connects the property with the Michipicoten Division of the Algoma Central and Hudson Bay railway at mile 20 from Michipicoten harbour on Lake Superior.

The iron formation consists of banded and massive chert, massive jasper, rusty granular chert, sideritic chert, and lenses of hematite and siderite. On the Josephine property it has a width varying between 200 and 400 feet.

No surface outcrops of hematite have been found but the presence of numerous boulders of good ore on the shore of Parks lake prompted diamond drilling beneath the waters of the lake. About 1902 the sinking of two shafts was commenced, both of which were discontinued and abandoned until exploration by drilling should have proven sufficient tonnage of ore to make a mine.

A deposit of hematite lying on the south side of the iron formation was located by this exploratory work, and its limits were pretty well defined. The deposit probably extends to a depth of 1,200 feet or more beneath the waters of the lake.

The owners (Alois Goetz and John McKay) estimate there is proven up 850,000 tons of ore running 59% iron, a very large percentage of which is of Bessemer grade, and that in addition there is a "very large tonnage of banded ore capable of being concentrated or roasted."*

The exploration has not given sufficient data for making any estimate of the tonnage of siderite.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 173.
Alois Goetz, Engineering and Mining Journal, Vol. 93, p. 1090.
John McKay, Port Arthur, Ontario, 1915.
Records of Exploration, Lake Superior Corporation, Sault Ste. Marie, Ontario, 1914.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 205.

*Reports furnished in February, 1918, by Malcolm A. McKay, of Port Arthur, Ont., give estimates ranging from 1,250,000 to 2,000,000 tons of ore proved up by the diamond drilling. At least 850,000 tons of this are believed to be recoverable. (*Signed*) A. H. A. R.

Bartlett Property.—

The Bartlett property lies in the southern part of township 28, range XXV, in the District of Algoma, and about one mile north of the Algoma Central and Hudson Bay railway at mile 23 from Michipicoten harbour on Lake Superior, and about one mile east of Josephine mine.

The iron formation in this property has a length of $1\frac{1}{2}$ miles, and for half this distance has an average width of over 400 feet, and a maximum width of about 600 feet. The remainder of the range varies from 50 to 200 feet in width.

The iron formation is composed chiefly of massive granular silica, often rusty, and a more or less continuous band of siderite which lies close to the south side. Pyrite is conspicuous in both the siliceous and sideritic phases of the iron formation.

References:—
A. Hasselbring for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
Records of Exploration supplied by Lake Superior Corporation, Sault Ste. Marie, Ontario.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 210.

In the central section of the Michipicoten iron area there are numerous occurrences of iron formation of lesser importance than those just described.

East of Michipicoten harbour and within $1\frac{1}{2}$ miles of it there are three outcrops, one known as the *Gibson Prospect*, none of which are of economic interest.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1902, p. 160.
Jas. Bartlett for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1913.

About 3 miles northwest of Helen mine is located the *Mildred Property* including an outcrop of iron formation $1\frac{3}{4}$ miles long. The range varies in width from 150 to 600 feet, and it consists of quartzitic and granular silica and some magnetite, pyrite and impure siderite.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1906, p. 181.
M. C. H. Little for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
Alois Goetz, Engineering and Mining Journal, Vol. 93, p. 1092.

The *Arnott Claims* include an iron range $1\frac{1}{2}$ miles long lying parallel to the Brooks Lake claims (Lucy mine) and three-quarters of a mile north of them. The iron formation is composed chiefly of granular silica, often rusty, and siliceous siderite, with here and there, small pockets of iron pyrites.

References:—
Peter Arnott, Helen Mine, District of Algoma, Ontario, 1915.
W. M. Goodwin for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
A. L. Parsons, Ontario Bureau of Mines, 1915, p. 209.

While not strictly belonging to the central section of the Michipicoten iron area the *Dog River claims* had best be considered here. They lie on the Lake Superior shore about 16 miles west of the Gros Cap outcrops, and are comparatively isolated from other iron range outcrops.

Iron formation outcrops are picked up not far from shore, about 4 miles west of Dog river, and they may be followed north and northwest for about 2 miles. The iron formation consists of banded white and grey chert and magnetite. A little specular hematite is exposed in some shallow workings. The greatest width of iron formation is under 200 feet. The occurrence is of no economic interest.

References:—

J. M. Bell, Ontario Bureau of Mines, 1905, pp. 316, 337.

L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.

Southern Section of the Michipicoten Area.

The southern section of the Michipicoten area stretches from Lake Superior on the west of the main line of the Algoma Central and Hudson Bay railway on the east, a distance of about 20 miles, and southerly from the Michipicoten river for about 16 miles. The northwest corner of the section is within 4 miles of Michipicoten harbour in the central section of the Michipicoten iron area.

Through the southern section iron formation outcrops are scattered quite plentifully, but generally without much regularity as to strike or continuity.

South of Michipicoten river banded iron formation is reported in several points near *Bridget lake* where it can be followed in one place from northeast to southwest for about 200 paces but with very unequal widths. It consists in some cases of black cherty-looking material with considerable magnetite, in others of a fine sandy-looking rock with little magnetite.

South of Bridget lake small outcrops of banded iron formation are found at the west end of *Junction lake*, at each end of *Island lake*, and between *Peter's lake*, and *Centre lake*. All these outcrops are of the sandy variety and without much promise of ore.

At the *outlet of Island lake* into Noisy river an occurrence of magnetite interbanded with a green silicate, some of which may be rich enough in iron to constitute an ore, is reported.

Farther south to the west of *Lake Mijinnemungshing* a number of claims have been located on iron formation which is very lean in iron.

About 2 miles southeast of *Cap Choyyé* a small deposit of impure hematite occurs but the amount to be seen is too small to give the deposit any practical importance.

Just east of *Anjigomi lake* at mileage 146·5 on the Algoma Central railway the most westerly of a series of iron formation bands is exposed in a rock-cut. These bands, are picked up towards the northeast for about three-quarters of a mile. The bands are not continuous for very long distances and the widths are usually under 20 feet. The largest exposures lie near the railway where there is a zone of iron formation rocks 50 feet wide but which includes several bands of rock.

The iron formation is composed of white, grey and black chert inter-banded, granular silica, both massive and banded, and pyrite and magnetite. Pyrite in small grains or narrow bands is plentifully present. Magnetite usually occurs in narrow bands but at one point near the railway track a siliceous phase of it constitutes nearly the whole width of the iron formation band. The enriched portion of the band has been test-pitted and a sample across a width of 35 feet is reported to have assayed as follows:—

Iron..............................	46·90	per cent.
Silica............................	23·00	"
Sulphur..........................	0·68	"
Phosphorus.....................	0·11	"

This is too low grade for present furnace requirements, and there is no considerable quantity of it. Because of the limited extent of the iron formation outcrops, and lack of evidences of concentration, there seems no probability of any deposits of ore of economic interest existing here.

About 4 miles west of the Anjigomi claims there is an outcrop of iron formation of considerable size along the boundary between townships 28 and 29, range XXII. About three miles farther west near *Lake Mishewawa* there occur a few small outcrops. A little to the north of this lake a belt of iron formation is picked up which stretches northwesterly for 2 miles with a width of a quarter of a mile, and crosses the Michipicoten river just below *High Falls*.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1906, pp. 177–181.
E. S. Moore, Ontario Bureau of Mines, 1906, p. 204.
B. E. Lalonde for R. H. Flaherty, Port Arthur, Ontario, 1909.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.

Batchawana River Area.

In *Palmer township* (about 35 miles north of Sault Ste. Marie, Ontario), two iron ranges have been located, one not far north of the south boundary of the township, and about 7 miles from Batchawana village on Lake Superior, and the other 5 or 6 miles farther north along the north boundary of the township.

The southern range (referred to locally as the *Batchawana mine*) is picked up at intervals for a distance of about 5 miles from east to west. The iron formation is composed chiefly of dull red jasper with which is associated some hematite and a very little magnetite. The jasper has undergone dislocations since it was formed and is in lenticular bands, sometimes brecciated, with the fissures filled with specular hematite. No work has been done to demonstrate the extent of the iron formation occurrences.

The northern range is mostly included in mining locations known as the *Heck lands* of which the *Mammoth mountain* and *Vulcan locations* have attracted most attention.

On this property there are two bands of iron formation a quarter of a mile apart, and paralleling one another. The iron formation outcrops are very siliceous being composed of alternating bands of light and dark-coloured granular silica and lean and high grade magnetite, the average thickness of the bands being about ½ inch. At some exposures magnetite constitutes 50 per cent of the rock and specimens of magnetite running 50 per cent iron may be secured.

The small amount of exploratory work done is entirely too little to demonstrate the areal extent of the iron formation, but it is undoubtedly large, one estimate being 75 acres. It is improbable that any large tonnage would average more than 35 per cent iron. Pyrite is present in sufficient quantity to give, in all probability, an undesirably high sulphur content.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1901, pp. 189–190.
G. M. Stewart for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1902.
B. E. Lalonde for R. H. Flaherty, Port Arthur, Ontario, 1909.
R. S. Rose, Marquette, Michigan, U.S.A., 1910.
A. P. Coleman, Ontario Bureau of Mines, 1914, p. 207.

In township 24, range XV, about 10 miles northeast of Pangis station on the Algoma Central and Hudson Bay railway, are located the *Drury iron claims.*

Stretching through these is a belt of iron formation composed of banded magnetite, dark jasper and schist. The occurrence is of no economic interest.

Reference:—
B. E. Lalonde for R. H. Flaherty, Port Arthur, Ontario, 1909.

Upper Goulais River Area.

Goulais River Iron Range.—

This is a range of iron formation lying just south of the Goulais river in township 22, range XII, and township 22, range XIII, and 9 miles east of Alva station on the Algoma Central and Hudson Bay railway. The northerly part of the range is included in the *Hilliar iron claims.*

Quite a little surface exploration has been done on the range, and a 10-ton sample of representative material was sent to the ore dressing plant of the Mines Branch, Ottawa, for concentration tests.

Because of the siliceous character of even the richest magnetite bands the Gröndal process was considered the only one feasible for this ore. The results of the experiments were disappointing for even after crushing until 76 per cent passed 200 mesh the iron contents of final concentrates from two experiments ran only 53·5 per cent, and 58·6 per cent iron respectively.

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.
Geo. C. Mackenzie, Mines Branch Summary Report, 1911, pp. 71–75.

Deroche Township Area.

Williams Mine.

This mine is located close to the southeast corner of Deroche township, and is about $2\frac{1}{2}$ miles southeast of Northfield (formerly Wilde) station on the Algoma Central and Hudson Bay railway, which is 24 miles from Sault Ste. Marie, Ontario.

The ore-bodies on this property lie in a belt of slate and quartzite. They are prevailingly narrow, and usually blend away into siliceous country rock. The ore consists of iron black, and lustrous specular hematite. A shaft was sunk to a depth of 200 feet and several hundred feet of drifting, and about 1,500 feet of diamond drilling was done.

In 1905 small shipments of ore were made to the steel plant at Sault Ste. Marie, but the results of exploration in 1904 and 1905 seem to have been discouraging for the mine has been idle since March, 1905.

References:—

W. E. H. Carter, Ontario Bureau of Mines, 1904, Part I, p. 75.
W. E. H. Carter, Ontario Bureau of Mines, 1905, Part I, p. 59.
E. T. Corkill, Ontario Bureau of Mines, 1906, p. 71.

Breitung Mine.

This mine, at one time called the Loon Lake mine, is situated on Loon lake about $1\frac{1}{2}$ miles southeast of Northfield station on the Algoma Central and Hudson Bay railway.

The ore formation is a greyish slate with a width of 300 to 400 feet. Through this there are pockets and streaks of hematite of varying degrees of purity.

The largest ore-body explored had a width of 50 feet. The central portion of this ore-body was clean ore, but on the south side particularly the ore became increasingly siliceous.

A shaft was sunk to a depth of 175 feet, a tunnel was driven about 300 feet, a few hundred feet of drifting was done, and a small tonnage of ore was stoped. In 1905 a little ore was shipped to the steel plant at Sault Ste. Marie, probably between 2,000 and 3,000 tons. The mine has been idle since 1905.

References:—

W. W. J. Croze for R. H. Flaherty, Port Arthur, Ontario, 1901.
W. E. H. Carter, Ontario Bureau of Mines, 1904, p. 75.
E. T. Corkill, Ontario Bureau of Mines, 1906, p. 71.

Hawkshaw-Derrer Property.

This property lies along the Algoma Central and Hudson Bay railway within $1\frac{1}{2}$ miles of Northfield station, and it corners on the Breitung property to the southeast.

Moran-Ferguson Property.

This lies immediately south of the Hawkshaw-Derrer property, and within two miles of Northfield station.

Poitras-Watt Claims.

These lie near Bellevue station on the A.C. and H.B. railway, and about two miles west of the Moran-Ferguson property just mentioned.

In the quartzite occurring on this property there are small areas showing concentrations of red hematite. Generally the hematite is decidedly siliceous, and the proportion of clean hematite in any one pocket is insignificant. A sample of the ore exposed in one showing is reported to have given the following analysis, which appears to fairly indicate the character of the ore occurring here.

Iron	36·50	per cent.
Silica	48·58	„
Sulphur	0·089	„
Phosphorus	0·005	„

References:—
B. E. Lalonde for R. H. Flaherty, Port Arthur, Ontario, 1909.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.

On the *McCauley claims*, two miles south of Bellevue station, there is an outcrop of titaniferous magnetite too small to be of interest. A sample from the ore outcrop gave the following analysis:—

Iron	39·00	per cent.
Silica	5·40	„
Sulphur	0·370	„
Phosphorus	0·015	„
Lime	0·50	„
Titanium dioxide	4·25	„

Reference:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1911.

Campbell Iron Claims.

Near the northwest corner of Deroche township are located the principal ore occurrences showing on the Campbell Iron claims. The property is reached by trail from Wabos station (mile 35) on the Algoma Central and Hudson Bay railway.

Strippings show that banded iron formation outcrops are fairly plentiful over an area measuring 200 feet by 1,500 feet. The probability is that in this area there are many small discontinuous bands of iron formation with nearly parallel strike. The best cross-section exposed in the surface operations is as follows:—

12 feet, greenstone.
53 „ banded iron formation.
25 „ greenstone.
6 „ lean iron formation, slaty and pyritic.

The iron formation is composed of alternating bands of granular silica and magnetite, the limits of the latter being rarely clean cut. At the largest exposure the siliceous part of the formation is largely red garnet. Average samples from two test-pits put down here showed the iron content to be about 30 per cent. A sample taken across a width of 55 feet of iron formation (B. E. Lalonde) gave the following analysis:—

Iron	34·13 per cent.
Silica	46·50 "
Sulphur	0·27 "
Phosphorus	0·11 "

A small shipment of siliceous ore was made to the American Gröndal Company for experiments in magnetic concentration. The Gröndal Company report that by grinding to 60–80 mesh a 63 per cent magnetic concentrate can be secured, the ratio of crude ore to concentrate being 2·1. The analyses of crude ore and concentrates are reported to have been as follows:—

	Iron.	Phosphorus.
Crude ore	38·20 per cent	0·110 per cent.
No. 1. Concentrate	55·67 "	0·060 "
No. 2. "	63·57 "	0·050 "
Tailings	14·92 "	0·150 "

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
B. E. Lalonde for R. H. Flaherty, Port Arthur, Ontario, 1909.
R. R. Rose for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1914.
American Gröndal Company for E. A. Sjostedt, Sault Ste. Marie, Ontario, 1911.

Aweres Township.

Near *Granite station* on the Algoma Central and Hudson Bay railway, and about eight miles north of Sault Ste. Marie, there is an iron formation outcrop disclosing cherty or quartzitic silica interbanded with magnetite. The general strike is N. 20° W., but as the belt is much contorted and penetrated by granite, the strike is far from uniform. The deposit is not large, and is too siliceous to be of use as an ore.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1901, p. 187.
A. P. Coleman, Ontario Bureau of Mines, 1914, pp. 207–229.

Macdonald Township.

On the *Armstrong-Henry property* (Section 36) a shaft was sunk 18 feet on a hematite prospect. Seams of hard rich specular ore are found. One diamond drill hole was put down about 280 feet. No encouraging results were secured.

Reference:—
P. A. Gough for R. H. Flaherty, Port Arthur, Ontario, 1900.

Meredith Township.

Section 31 is known as the *Armstrong-Henry property*. Here a couple of shallow shafts and some test-pits were sunk on showings of hard and soft hematite occurring in quartzite. A diamond drill hole showed only 15 inches of good ore beneath the best surface showing. Exploration was discontinued because of discouraging results.

Reference:—
J. Kellerschon for R. H. Flaherty, Port Arthur, Ontario, 1900.

Aberdeen and Aberdeen Additional Townships.

The *Palms property* (Lot Y-8 Aberdeen) lies about $8\frac{1}{2}$ miles north of Desbarats station on the Canadian Pacific railway. On a hematite showing here three diamond drill holes were put down and a trench 75 feet long excavated. The quartzite in which the exploration was made shows only seams of very lean ore, and discolorations of red oxide.

Reference:—
P. A. Gough for R. H. Flaherty, Port Arthur, Ontario, 1900.

Stretching through *lots 11 and 12, concession IV* (*Aberdeen*) and the north halves of *lots 1, 2 and 3, concession IV*, the south half of *lot 3, concession V* (Aberdeen *Additional*), there is a belt of grey slate in which there is a ferruginous zone along the contact with the quartzite to the southwest. In this zone the hematite where it occurs in pockets or veins is iron-black and bluish in colour and compact, and where disseminated is of the specular variety. The best showing (not over 100 feet in length) has a maximum width of six feet of merchantable ore, and on either side the ore becomes increasingly siliceous. A shaft 32 feet deep (on the south half, lot 12) encountered seams of high grade specular ore from six inches to four feet in width.

Four diamond drill holes with an aggregate depth of 1,000 feet were put down in 1903 to explore the most promising portions of this ore-band. Iron ore was encountered in three holes at depths of 150, 60, and 160 feet respectively. At these depths the respective widths of the ore were as follows: 3 bands 1 foot wide in an 8-foot width of the formation; 2 bands 2 feet wide separated by 2 feet of quartzite; and 10 feet in one band. The slate on one or both sides of the iron-bearing quartzose rock is ferruginous for widths of several feet.

On lot 6, concession III (Aberdeen Additional) there is a white quartzite occasionally stained red with earthy hematite, and containing thin seams of specular hematite.

References:—
P. A. Gough for R. H. Flaherty, Port Arthur, Ontario, 1900.
A. P. Coleman, Ontario Bureau of Mines, 1901, p. 188.
W. E. H. Carter, Ontario Bureau of Mines, 1904, p. 76.

At the *Stobie iron mine* near the west end of Gordon lake, mining operations were carried on between 1874 and 1878. Hematite was extracted by two tunnels from a vein with width varying from 2 to 11 feet. Several vessels loads of ore were shipped to Detroit.

References:—
Ontario Bureau of Mines, 1892, p. 64.
Geol. Sur. Can., Annual Report, Vol. XV, 1902–03, p. 253A.

Johnson Township.

Private reports were made in 1874 and again in 1891 on iron ore occurrences found on the "Desbarats location."

At a later date (in 1897) additional exploration was done in this vicinity for iron ore, but apparently without satisfactory results.

References:—

R. G. Leckie and John Wearne for the owners, 1874.
A. Mackenzie for the owners, 1891.
A. Slaght, Ontario Bureau of Mines, 1897, p. 97.

Parkinson Township.

On the north half of the south half, *lot 7, concession 1*, several parallel bands of lean magnetite occur in a dark hornblendic rock, the exposure being a rocky bluff with a face 50 feet high.

Reference:—

D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

VI. DISTRICT OF MANITOULIN.

Frazer Bay Claims.

This property lies on Frazer bay, an arm of Georgian bay, and is about 15 miles east of the town of Little Current on Manitoulin island. It includes an area of white quartzite on the north shore of Frazer bay, in which there are zones of iron-bearing slate. The area measures about one mile from north to south, and four miles from east to west.

In 1914 the property was being explored by diamond drill.

References:—

L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
C. W. Knight, Ontario Bureau of Mines, 1915, p. 228.

VII. DISTRICT OF SUDBURY.

Chapleau Area.

McVittie Locations near Nemegos Station.

These locations (W.D. 275 and 276) are situated in the township of McNaught, about five miles northeast of Nemegos station on the main line of the Canadian Pacific railway.

Syenite, often porphyritic, is the rock nearly everywhere exposed in this vicinity. In smaller proportion appear granite and a dark basic-looking rock, possibly a re-crystallized gneiss or schist. A thin section of the latter was found to be composed of 35% hornblende, 35% quartz, 20% orthoclase, and 10% magnetite. A sample of this rock carried 8·81% iron, and 0·31% titanium dioxide. The presence of this small proportion of magnetite is probably accountable for the feeble attraction for the magnetic needle observed at different points where the rock was obscured by drift.

In the dark-coloured rock there are numerous pockets of lustrous titaniferous magnetite. These pockets vary from the size of a plum up to one showing a cross-section with an area of 90 square feet. The ore everywhere seems uniform in texture and composition. The boundaries of the ore pockets seem devoid of any regularity. In quarrying there is no tendency for ore to break free from country rock.

A few trenches and test-pits have been dug, and from the largest outcrop a shipment of about 125 tons of ore was made.

From the surface work, and a magnetic survey, it appears that the ore outcrops are portions of small isolated deposits, connected in some instances by rock formation carrying a little magnetite. Indications hardly warrant the expenditure of much money for diamond drilling or development.

Analyses of two general samples taken from natural outcrops in 1909, are as follows:—

	No. 1	No. 2
Iron..................	63.5 per cent.	51·81 per cent.
Titanium dioxide.......	12·5 „	11.91 „

References:—
B. F. Haanel, Mines Branch, Summary Report, 1909, p. 110.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.

Woman River Area.

The Woman River iron ranges are included in a belt of territory which extends from the northeast end of Lake Sahkatawichtah southwesterly across the Rush river, and along the Woman and Ridout rivers to a point about eight miles northeast of Ridout station on the Canadian Pacific railway main line, a distance in all of about 40 miles.

The most attractive looking portions of the iron range outcrops have been staked for iron, and the principal holdings from northeast to southwest are known respectively as the Smith, Leith, Drummond and Dobie, McLaren and Marks claims.

Smith Claims (Jefferson Iron Mine).

These extend with a trend slightly south of west from the northeast end of Lake Sahkatawichtah to the Rush river, a distance of about three miles. The distance south by canoe route to Bisco on the Canadian Pacific railway main line is approximately 60 miles. The Canadian Northern Transcontinental line lies about 20 miles to the east.

Except for a few short intervals a band of iron formation can be traced for the whole length of the property. The iron formation, which varies from a few feet to 300 feet in width, is composed of cherty and granular silica, generally banded, and along its south side are found irregularly-shaped lenses and pockets of intermixed magnetite, pyrite and pyrrhotite.

The deposits at the easterly end of the property have the highest iron content and are best described as lenses of magnetite impregnated fairly uniformly with pyrite and pyrrhotite. Following the range westward the proportion of pyrite and pyrrhotite increases, and some outcrops show a fairly good grade of pyrite.

A considerable amount of trenching and diamond drilling has been done on the property, showing up large tonnages of mixtures of magnetite, pyrite and pyrrhotite of varying proportions.

The best looking deposit of magnetite has an average width of from 35 to 40 feet and a length of 4,000 feet. At two points, about 1,700 feet apart, it is proven to maintain its surface width at depths of 300 and 380 feet respectively.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.
H. Bradley for R. H. Flaherty, Port Arthur, Ontario, 1912.
W. E. Smith, Sudbury, Ontario, 1914.

Leith Claims.

The Leith claims are the next group west of the Smith claims, and they cover the iron range outcrops for a distance of about six miles, the strike of which in this property is approximately northeast and southwest. The Rush river passes just east of the claims, and the Woman river crosses them about two miles farther west.

East of the Woman river the iron range is not well defined. To the west it occurs in three main belts. No. 1 belt, the most westerly, lies in claims W.S. 10, 11, and 12. Its strike is northwest and southeast at right angles to the general trend of the range. Its length is about one mile and its extreme width about 850 feet. Belt No. 2 is in claims W.S. 9 and 8. The length from northeast to southwest is about three-quarters of a mile, and the maximum width is 1,400 feet. Belt No. 3, extending through claims W.S. 8, 7, 4, 5, and 6 has a slight break in W.S. 7. The southwesterly portion (in W.S. 7) strikes about north and south, has a length of nearly three-quarters of a mile, and a maximum width of about 1,300 feet. The extension northeasterly through W.S. 4, 5, and 6 has a length of nearly $1\frac{1}{2}$ miles, and an average width of nearly 900 feet.

The iron formation is made up of finely banded cherty iron carbonate rocks, hematitic, magnetitic and pyritic cherts, an amphibole-magnetite rock, black and red jaspilytes and iron ores.

Great variation in character of the iron formation, both in the direction of strike and across it, is a marked feature of all the belts, yet in a broad way the range may be divided into several areas, each of which is characterized by the relative prominence of one of the various phases of the formation. In general, ferruginous cherts are dominant toward the southwestern end, and the jaspilytes are prominent toward the northeast in claims W.S. 4, 5, and 6. The amphibole-magnetite rocks are abundant in claim W.S. 8, while the unaltered iron carbonate rocks have been found only on claim W.S. 6, and in a few places east of Woman river.

Locally, particularly in claims W.S. 11 and 12, iron ores occur. On these claims the ore is low grade, running as high as 43 per cent in iron in places with phosphorus content of about 0·018 per cent. A small amount of sulphur is present as pyrite.

Reference:—
R. C. Allen, Ontario Bureau of Mines, 1909, pp. 254–262.

Drummond-Dobie Claims.

This group of claims lies about eight miles southwest of the Leith claims, and about 12 miles northeast of Wakami siding on the Canadian Pacific railway. The claims are situated on both sides of Speight's meridian, about 16 miles north of the C.P.R., and lie immediately south of the Ridout river.

On the property there are two main belts of iron formation, and a few smaller ones. The main belts strike a little south of east, have lengths of about three miles, and they lie about half a mile apart.

The northern belt, which has a width of about 200 feet, is composed of interbanded magnetite and silica. While picked specimens of ore running as high as 63 per cent iron have been secured, assays appear to indicate an average iron content of about 35 per cent for the range.

The southern belt, the width of which varies from 300 to 900 feet, is reported to consist of massive magnetite. Assays indicate an average iron content probably above 40 per cent. The character of the massive ore is somewhat varied; in places it is free from sulphides, and in others it is heavily impregnated with pyrite and pyrrhotite (cf. Smith claims pp. 90–91). A series of analyses show the following ranges:—

Iron..............	35·62 per cent.	—	63·50 per cent.
Silica..............	4·20 „	—	48.73 „
Sulphur...........	0·04 „	—	20·15 „
Phosphorus........	0·02 „	—	0·15 „
Manganese.........	0·30 „	—	0·47 „
Titanium..........		Traces.	

Messrs. *Clemont and Gordon* have claims staked adjacent to those just described, but there is no information available concerning their showings.

Reference:—
Thomas Drummond.

McLaren Claims.

These claims include outcrops of iron formation lying from three to five miles southwest of the Drummond-Dobie claims. They lie west of the 16th mile of Speight's meridian, and about 10 miles northeast of Sultan siding on the Canadian Pacific railway.

This iron formation area is conspicuous in that it is at a higher elevation than the surrounding country for many miles in all directions.

The iron formation rocks constitute probably 75 per cent of the rock areas exposed on the eight claims, and their areal extent is probably more that 25 per cent of the total area of the claims.

The longest belt of iron formation can be followed from a point a little east of the second portage on Isaiah creek with only one break (of about five chains) for a distance of $1\frac{1}{4}$ miles southeasterly. The westerly portion is nearly $\frac{3}{4}$ mile long and varies from 200 to 350 feet in width; the southeasterly portion is nearly $\frac{1}{2}$ mile long and has a maximum width of about 600 feet.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.
A. A. McLaren, Chapleau, Ontario, 1915.

Marks Claims.

About five miles north of the McLaren claims, and about three or four miles northwest of the Drummond-Dobie claims lie the Marks claims, which cover an area four miles long from east to west, and $\frac{1}{2}$ mile wide. They are situated on the north side of the Ridout river, about 15 miles northeast of Ridout station on the Canadian Pacific railway, from which point they may be reached by a six-hour canoe trip.

Reference:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.

Claims West of Cache Lake.

To the west and southwest of Cache lake, and about eight miles northeast of Ridout station, two groups of iron claims have been staked, the Moore and Clemont group, and the Marks group. These mark the most southwesterly limit of the Woman River iron range.

Reference:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.

Groundhog River Area.

The Canadian Northern railway transcontinental line near its crossing of the Groundhog river, 150 miles northwest of Sudbury, crosses an iron range striking east and west through the Townships of Keith and Penhorwood. Claims have been staked along this for a distance of about six miles.

Algoma Eastern Railway Claims.

These claims lie along both sides of the Groundhog river about $\frac{1}{2}$ mile below the Canadian Northern railway crossing. On them an iron range, 75 feet wide and 1,200 feet long, has been shown up by trenching. Surface relief shows a vertical extent of at least 75 feet. No sinking or diamond drilling has been done.

Three representative analyses are given below. No. 1 sample was a groove sample across 75 feet of iron formation; No. 2 was across 13 feet, and No. 3 was a picked specimen of the best ore exposed.

	No. 1	No. 2	No. 3
Iron..........	37·02%	40·28%	63·07%
Silica..........	45·84%	39·29%	11.92%
Sulphur.......	None	None	0·18%
Phosphorus....	0·035%	0·062%	Trace
Titanium......	None.		None
Alumina.......	1·43%		
Lime..........	None.		

The iron range is composed of magnetite and hematite interbanded with jasper and occasionally with iron-magnesia silicates.

A 20-ton sample was sent to the ore dressing plant of the Mines Branch, Ottawa, for concentration tests. The crude ore ran 34·41 per cent iron. The best results secured from a series of experimental runs showed only a 60·5 per cent recovery of the iron contents, and gave a concentrate running only 49·8 per cent iron.

References:—
W. G. Miller, Ontario Bureau of Mines, 1903, p. 315.
J. A. Dresser for Algoma Eastern Railway, 1914.
W. B. Timm, Mines Branch, Summary Report, 1913, pp. 81–88.

Shining Tree Lake Area.

Shining Tree lake area lies along the boundary between the districts of Sudbury and Timiskaming, and is about 75 miles due north of Sudbury, and about 28 miles northeast of Ruel station on the Canadian Northern railway.

A number of iron range occurrences in this vicinity have attracted attention. Some lie in the District of Sudbury, and some in Timiskaming. The former will be described here.

Big Four Locations.

This property consists of mining locations W.D. 480, 481, 482, and 483, situated at Big Four lake in the township of McMurchy, about seven miles northwest of Shining Tree lake.

Iron formation is reported to extend for a distance of 2,800 feet across the property with a width varying from 200 to 300 feet. The iron formation consists of chert, white, grey, black and resinous in appearance, granular silica, red and brown in colour, cherty rocks with white, red and brown cappings, granular siliceous iron oxides, red jasper and magnetite, hematite and pyrite, the iron ores being very sparingly present. Distinct banding characterizes only small areas. At one exposure clean magnetite in bands up to $2\frac{1}{2}$ inches in thickness constitutes about one-fifth of the iron formation.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.
J. F. Black, Sudbury, Ontario, 1914.

Mining Locations W.D. 475, 476, 477, and 478.

These lie along the 62nd and 63rd miles of the Sudbury-Timiskaming district line, about two miles north of Shining Tree lake. They include an iron formation band which can be traced for some distance to each side of the district line.

To the northwest the iron formation stretches for a mile with a maximum width of 100 yards. It is composed of jasper (not very bright red in colour) and chert, usually greyish-black, both more or less interbanded with magnetite. Pyrite occurs not infrequently in the chert. At some points the iron formation has a brown capping.

To the southeast in the district of Timiskaming the range can be picked up at frequent intervals for $3\frac{1}{2}$ miles. This portion of the range is composed chiefly of jasper, often bright red. At some points the jasper is interbanded with purplish magnetite. No ore of value was seen.

References:—
E. M. Burwash, Ontario Bureau of Mines, 1896, p. 174.
A. P. Coleman, Ontario Bureau of Mines, 1901, p. 183.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

Onaping Lake Area.

About three miles east of the north end of *Onaping lake*, and between it and Meteor lake, red jasper associated with magnetite is found on a long ridge. The ridge strikes northwest and southeast.

Reference:—
A. P. Coleman, Ontario Bureau of Mines, 1901, p. 187.

A report on the property of the *Onaping Iron Company* near Onaping lake says there are areas of banded iron formation with occasional pockets of ore averaging from 35 to 50 per cent iron. Considerable test-pitting, trenching and stripping has been done.

Reference:—
H. E. Knobel for D. D. Mann, Toronto, Ontario, 1909.

Burwash Lake Area.

Near Burwash lake, 16 miles north of Moose Mountain mine, there are numerous outcrops of iron formation composed of interbanded silica, magnetite and green hornblende, and entirely enclosed by intrusive granite-gneiss. The richest formation contains probably less than 30 per cent iron. The larger deposits after exploration by diamond drilling were abandoned.

Reference:—
W. H. Collins, Geological Survey of Canada, Summary Report, 1912, p. 311.

Roberts and Botha Townships.

On lots 3 and 4, concession IV, Roberts township, there are two prominent iron formation outcrops besides several minor ones.

The westerly exposure shows a section of banded granular silica and magnetite about 15 feet thick dipping to the west at only a few degrees from the horizontal.

The other outcrop lies $\frac{1}{4}$ mile east of the one just described. This shows a flat-lying bed of banded granular silica and magnetite dipping at a low angle to the west. The thickness of the bed probably does not exceed 20 feet.

The average iron content of the iron formation outcrops is probably between 30 and 35 per cent.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

Near *Morin lake* in Roberts township, two iron formation bands are reported. The band in Location W.R. 121 is about 150 feet wide and 1,400 feet long. The iron formation consists of alternating bands of silica and magnetite, and would probably average less than 30% iron. The outcrop on W.R. 108 shows a small area of banded iron ore and silica lying nearly flat with slight dip to the northwest. The total thickness is from 12 to 15 feet. This iron formation appears to have a very low iron content.

Stretching westward from *McCrindle lake,* which lies on the west boundary of Roberts township, there is a belt of lean banded iron formation extending to and beyond *Roam* and *Sandfly lakes,* a distance in all of nearly seven miles. This lies wholly in Botha township.

Reference:—
M. T. Culbert, Ontario Bureau of Mines, 1904, Part I, pp. 222–224.

Moose Mountain Area.

The expression Moose Mountain area is here applied to an area of some four square miles extending northwesterly from lot 6, concession III of Hutton township, into the adjoining township of Kitchener, a distance of $4\frac{1}{2}$ miles. It includes the ore-bodies known as Moose Mountain mine, located at the village of Sellwood on the Canadian Northern railway, and many undeveloped iron formation bands, the whole group being sometimes referred to as the Hutton Township Iron Range.

In the Moose Mountain area 11 deposits of all grades have been delimited by surface exploration and magnetometric surveys. (See maps Nos. 205, 206, 207, 208, 208A, 208B, 208C, Vol. I). The iron ores of the area may be divided into two types.

Type A: Those in which magnetite is found in irregular masses, associated with pyroxene, hornblende and epidote.

Type B: Those consisting chiefly of fine-grained siliceous magnetite interbanded with siliceous material including chert and phases resembling quartzite.

To Type B may be assigned all the deposits except Nos. 1 and 5. The following is the analysis of an average sample across No. 2 deposit, and it is probably fairly representative of the deposits of Type B:—

Iron	36·70 per cent.
Silica	45·20 "
Sulphur	0·024 "
Alumina	0·250 "
Lime	1·06 "
Magnesia	1·59 "
Manganese	0·04 "

The exceedingly fine texture and the intimate association of the magnetite with the silica render it impossible to obtain a marketable product from this type of ore by a simple cobbing process, and it is only by a very fine grinding of the material that a satisfactory separation of the magnetite from the silica can be attained. Tests carried out by Moose Mountain, Limited, have shown that by crushing the ore to 160 mesh, and passing it through a Gröndal magnetic separator, a concentrate of approximately the following composition can be secured:—

Iron	63·02 per cent.
Silica	6·66 "
Sulphur	0·012 "
Phosphorus (probably)	0·020 "
Alumina	1·00 "
Lime	1·50 "
Magnesia	1·53 "
Manganese (probably)	0·04 "

It is almost unnecessary to add that this fine concentrate requires either nodulizing, briquetting or sintering before it can be utilized in the blast furnace for the manufacture of pig-iron.

Deposits Nos. 1 and 5 belong to Type A described above. These two deposits are comparatively small, their aggregate area being only 71,000 square feet. So far the principal mining operations have been confined to these deposits. The horizontal area of No. 1 deposit is 47,000 square feet, most of which has already been opened up. By diamond drilling the ore-body has been proved to a depth of 300 feet below its highest outcropping.

Mining operations at No. 1 deposit have demonstrated that the magnetite, hornblende and epidote often show a more or less pronounced segregation into irregular layers and lenses. For this reason it is almost impossible to give any figures which may be said to represent the average iron content of this type of ore. Some parts of the ore-body average 60 to 65 per cent iron, while others, often in the immediate vicinity, consist of hornblende, or epidote; and between these two extremes all gradations exist. The following analysis gives the average composition of the 1914 shipments of concentrates crushed to pass one-inch ring and screened on an 8 mesh screen:—

Iron	54·45	per cent.
Silica	14·55	"
Sulphur	0·036	"
Phosphorus	0·105	"
Alumina	2·09	"
Lime	4·00	"
Magnesia	2·83	"
Manganese	0·07	"
Loss by Ignition	0·75	"

The total area of the various deposits is roughly estimated as 3,256,000 square feet, of which 3,185,000 square feet is the area of the low grade deposits of Type B. Assuming that the average specific gravity of the ore is 3·8 there should be 38,665,000 tons of siliceous ore for every 100 feet in depth of the ore bodies. The actual depth of the various deposits is not known at present, but diamond drilling carried out by Moose Mountain, Limited, has shown that No. 2 deposit is at least 300 feet deep at one point; while No. 1 deposit has been proved to a depth of 300 feet. Unfortunately, the great bulk of this large tonnage is made up of banded siliceous magnetite of Type B, requiring fine crushing and concentration, with subsequent briquetting, nodulizing or sintering before it can be made marketable. As noted before, mining operations have been confined to No. 1 deposit, where the local character of the ore has made it possible to obtain a merchantable product by a simple cobbing process. But, the amount of this type of ore being limited, it is evident that the future of the district as an iron ore producer depends chiefly on the possibility of utilizing the banded siliceous magnetite of Type B. Being well aware of this fact, the operating company, in 1912, erected a modern Gröndal concentrating and briquetting plant, which, when fully completed, is planned to have a capacity of 800 tons of crude ore per 24 hours. Concentration tests have, as already stated, demonstrated that by grinding the material sufficiently fine (160 mesh) an excellent concentrate having the following composition can be obtained:—

Iron	65·6	per cent.
Phosphorus	0·019	"
Silica	8·6	"
Sulphur	0·012	"

It remains to be seen, however, if this concentrating and briquetting process can be economically carried out. The cost of mining the ore will, no doubt, for years to come, be rather low, owing to the fact that a large tonnage can be obtained from No. 2 deposit by simply quarrying the ore in open-cuts at various elevations. Cheap electric power is now available, being obtained from Wahnapitae Power Co., over a transmission line about 35 miles in length.

Since it will be necessary to mine and crush to a fineness of 160 mesh about 2·1 tons of ore in order to obtain one ton of concentrate of 65 per cent iron, and since to the cost of mining, crushing and concentration, there must be added that of briquetting (which by the Gröndal process is rather high) it is evident that only by the most economical handling of the material, on a large scale, will it be possible, at the present time, to work these low grade ores profitably.

References:—
C. K. Leith, Ontario Bureau of Mines, 1903, pp. 318–321.
A. P. Coleman, Ontario Bureau of Mines, 1904, pp. 216–221.
E. Lindeman, Moose Mountain Iron Bearing District, 1914. Mines Branch, Ottawa, Canada, No. 303.
F. A. Jordan, c/o Moose Mountain, Limited, Sellwood, Ontario, 1914.

Moose Mountain Mine.

For detailed description see Vol. I.

Wisner and Bowell Townships.

Clear lake lies in lots 9, 10, and 11, concession VI of Wisner township, about four miles southwest of Sellwood village on the Canadian Northern railway. A short distance to the south of this lake several outcrops of interbanded quartzitic silica and magnetite have been located. The greatest width of any outcrop seen was 24 feet, and the bands were nowhere traceable for much more than 100 feet. As ore deposits they are of no importance, the proportion of magnetite being too small; and the presence of pyrite still further lowers the quality.

Similar bands of iron formation are found a few miles west of Clear lake in lots 1 and 2 of concessions V and VI of Bowell township. Some of these were explored by diamond drill in 1908 and 1909 with unfavourable results.

References:—
A. P. Coleman, Ontario Bureau of Mines, 1901, pp. 185 and 186.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.

Wanapitei Lake Area.

At the northwest of Wanapitei lake, iron formation outcrops have been located on different lots in Rathbun, Norman, and Parkin townships. This iron-bearing area lies about ten miles southeast of Moose Mountain mine at Sellwood, and about six miles east of Norman station on the Canadian Northern railway.

In *Rathbun township* iron formation outcrops occur in lots 22, 23, and 24, concession VI.

One group of outcrops lies near the east side of lot 22 not far from the shore of Wanapitei lake. The iron formation is composed principally of quartzitic silica interbanded with siliceous magnetite. It also includes areas of reddish jasper interbanded with both lustrous steely-looking magnetite, and dark-coloured hematite. A few bands of ore four or five inches wide and two to three feet long were observed.

To the northwest of this on a high hill in lot 24 lies the largest exposure of iron formation. This varies in width from 125 to 600 feet, and has a length of 1,500 feet.

The iron formation consists of cherty and granular silica interbanded with magnetite. Generally speaking the magnetite bands are sparingly present. Their thickness rarely exceeds two inches and is usually very much less.

On several of the smaller exposures between the two groups described there is a rusty capping due to oxidation of sulphides occurring in the silica.

On *lots 3 and 4, concession VI in Norman township* (a mile or more west of the Rathbun township outcrops) there are numerous outcrops of very siliceous banded iron formation. The iron mineral is magnetite, and the maximum thickness of the magnetite bands is one inch. A little pyrite is disseminated through the silica. The size and mode of occurrence of the outcrops suggest the presence of a number of isolated deposits of iron formation rather than one or more of good size.

On lot 3, concession I in Parkin township, immediately to the north of the Norman township outcrops, there are a few natural outcrops of iron formation of similar character to those in Norman.

References:—
W. G. Miller, Ontario Bureau of Mines, 1901, p. 177.
M. T. Culbert, Ontario Bureau of Mines, 1904, p. 224.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

Cartier Area.

The *Geneva Lake property* consists of some claims along the south boundary of the township of Munster, and about four miles north of Geneva lake, and five to six miles north of the Canadian Pacific railway main line.

The ridge on which the workings are located consists of a soft dark-green chloritic rock which contains inclusions of light-greenish to white, sometimes banded, quartzose material. There are irregular patches of segregations of crystallized magnetite with chlorite scattered through the greenstone. Chlorite and magnetite are also associated with the quartzose inclusions, and contained in them.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

Whissell Claims.

The Whissell claims are located in Moncrieff township, and lie along both sides of the Canadian Pacific railway, about ten miles west of Cartier village. On them there are exposed several bands of granular silica through which there is disseminated pyrite and pyrrhotite. The bands are narrow and short. They all have a rusty capping due to the oxidation of contained sulphides. As iron ore prospects these are of no interest.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1912.
H. Bradley for R. H. Flaherty, Port Arthur, Ontario, 1912.

Groves Claims.

These claims are located in lot 7, concession III, of Hart township, and are about six miles southwest of Cartier.

A considerable amount of stripping has revealed many pockets of magnetite, some of which is of fair quality. The small size of the pockets, and the limited extent of the ore-bearing areas give no promise of any tonnage of interest of marketable ore.

References:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1910.
H. Bradley for R. H. Flaherty, Port Arthur, Ontario, 1912.

Whitefish River Area.

The *Wallace Mine location* is located on the north shore of Lake Huron just west of the mouth of the Whitefish river, and about ten miles north of the town of Little Current.

In the northwest corner of the location a vein of hematite occurs in quartzite. The vein, where a pit has been sunk in it, has a width of eight feet, but it contains some inclusions of rock. The ore vein may be traced by natural outcrops 200 to 300 yards westward, but it is only two feet wide where last visible.

References:—
Royal Commission on Mineral Resources of Ontario, 1890, p. 123.
G. L. Michael for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.

On the Whitefish Indian Reserve (just east of the Wallace Mine location) 207 feet of diamond drilling was done on an iron prospect in 1903. The only indications of iron met with appear to have consisted of fragments of ore in drift boulders, and an occasional softer band of the quartzose rock impregnated with hematite.

Reference:—
Ontario Bureau of Mines, 1904, p. 43.

VIII. DISTRICT OF TIMISKAMING.

Mattagami River Area.

At *Grand Rapids on the Mattagami river*, about 80 miles north of the National Transcontinental railway, limonite deposits of considerable size are found in Devonian limestone.

On the northwest side of the river, at the foot of the rapids, there is an outcrop of limonite, with an exposed breadth of 20–25 feet, running along the foot of a cliff almost continuously for a distance of upwards of 300 yards. The highest points rise about fifteen feet above the level of the river. The ore is believed to be an oxidation product of siderite, found associated with the limestone at the head of the rapids, where similar deposits of limonite occur in two places. These extend across the bed of the river and stretch along the shore for about 1,100 feet in each case. They reach in places 15 to 18 feet above the level of the river, but their full thickness cannot be estimated, as they extend below water level in almost every case. Nor could it be ascertained how far they extend inland from the banks of the river.

In places the ore is a soft, often botryoidal, vuggy limonite in radiating, lumpy masses. At other places it is a dense hard hematite or compact limonite. Again it passes into coarse conglomerate, composed of small water-worn pebbles of quartz in a matrix of clay and limonite. The deposits are, therefore, of a very mixed character, in some places the material being high enough to constitute a fair ore, while in others it is quite low in iron content. Analyses of representative samples of the ores exposed are given herewith.

	1	2	3	4	5
Iron.......	52·45%	52·10%	41·68%	37·35%	36·68%
Sulphur...	0·14%	0·11%	0·15%	0·16%	0·60%
Phosphorus	0·08%	0·14%	0·12%	0·13%	0·09%
Moisture..	1·16%	0·94%	1·70%	1·56%	1·42%

Sample No. 1. Average of the best ore at the foot of the rapids on the north side.
Sample No. 2. Best ore below high water mark at the foot of the rapids on the north side.
Sample No. 3. Average ore from the foot of the rapids, south side.
Sample No. 4. Average of the best ore at the head of the rapids, south side.
Sample No. 5. Average of 850 feet of exposure at the head of the rapids, south side.

The siderite from which the iron oxides are supposed to have been formed is of exceptionally high grade as is shown by the following analysis:—

Iron.....	42·37 per cent.	Lime..............	1·47 per cent.
Silica....	1·40 „	Magnesia..........	Trace
Sulphur.	None	Manganese oxide...	1·74 „
Alumina.	2·31 „	Carbon dioxide.....	34·94 „

References:—
J. M. Bell, Ontario Bureau of Mines, 1904, pp. 152–156.
M. B. Baker, Ontario Bureau of Mines, 1911, pp. 238–246.

Opasatika River Area.

Near *Breakneck falls on the Opasatika river*, about 25 miles above the mouth of the river, and about 40 miles north of the National Transcontinental railway, there are numerous outcrops of iron-bearing rocks. The varieties noted are poorly ferruginous magnesian limestone, richly ferruginous magnesian limestone, siderite, and siliceous limonite or göthite and hematite. The rock is usually coloured a deep ochre, or dark red, and in texture is, as a whole, soft, dense, and fine-grained, containing numerous geodes of quartz crystals and veinlets of specular hematite. It is sometimes botryoidal and even stalagmitic. The rock is never sufficiently rich in iron to be graded as an iron ore. The following analyses represent chemically the character of the iron-bearing rocks:—

	Siliceous hematite.	Ferruginous limestone.	Siderite.
Iron	24·39%	3·09%	43·47%
Silica	53·14%	1·00%	
Sulphur	0·15%		
Phosphorus	0·028%		
Alumina	1·10%	0·56%	
Lime	1·95%	29·36%	
Magnesia	1·14%	19·56%	
Manganese dioxide	0·66%		
Loss on ignition	6·40%	44·40%	37·9%

It is impossible to make any accurate estimate of the extent of the iron-bearing rocks as they lie about horizontally and are exposed only on the river banks, but the total volume is undoubtedly large.

Reference:—
J. M. Bell, Ontario Bureau of Mines, 1904, p. 150.

Abitibi Area.

About the middle of the west shore of *Lower Lake Abitibi, on Island No. 14*, and on the mainland immediately north of that, are two outcrops of jaspilyte iron formation. The dip of the formation is practically vertical and the strike is 23° north of east. The iron formation consists of alternate bands of magnetite and silica. The width of the outcrops is 60 feet, but the length of the deposit could not be determined owing to a heavy covering of soil.

Reference:—
M. B. Baker, Ontario Bureau of Mines, 1909, p. 276.

Munro and Warden Townships.

On *lot 10, concession II*, and other parts of Munro township, exposures of iron formation, consisting of narrow, alternating bands of sugary quartz and magnetite, and dipping vertically, are enclosed in the greenstones.

On *lot 10, concession I*, of Warden township, the white-weathering serpentine contains a network of numerous veinlets of magnetite which withstand weathering and project above the serpentine.

Reference:—
P. E. Hopkins, Ontario Bureau of Mines, 1915, p. 176.

Porcupine Area.

Whitney Township.

Banded iron formation outcrops frequently in the southwest part of Whitney township in the first and second concessions. The bands are alternate reddish, or greyish quartz, and magnetite and hematite. Sometimes the narrow bands of magnetite, one-eighth inch thick, carry a merchantable percentage of iron, but these are relatively subordinate in comparison with the main mass of rock. It is unlikely that merchantable iron will be found in quantity.

Reference:—
A. G. Burrows, Ontario Bureau of Mines, 1912, p. 213.

Deloro and Shaw Townships.

In Deloro and Shaw townships bands of banded iron formation can be traced for several miles in a direction a little south of west. Often the formation carries no iron ores with the result that it greatly resembles a wide quartz vein. Bands of carbonate rocks are closely associated with the iron formation for a distance of several miles.

Reference:—
A. G. Burrows, Ontario Bureau of Mines, 1912, pp. 213, 214.

McArthur Township.

Iron formation bands are found among the Keewatin rocks in the southeast quarter of McArthur township. The largest body of iron formation is on a trail about one mile east of *Triple lake*. It consists of banded silica and magnetite, some bands of which are an inch in width.

Reference:—
P. E. Hopkins, Ontario Bureau of Mines, 1912, p. 278.

MONTREAL RIVER, EAST BRANCH.

Shining Tree Lake Area.

In the southwestern quarter of *Tyrrell township* unimportant outcrops of iron formation are found for a distance of $3\frac{1}{2}$ miles, the iron formation being composed chiefly of jasper, often bright red, which at some points is interbanded with purplish magnetite. This is an extension of the range in Mining Locations W.D. 475, 476, 477, and 478, described among the Sudbury District iron ore occurrences

References:—
A. P. Coleman, Ontario Bureau of Mines, 1901, p. 183.
W. H. Collins, Geol. Sur. Can., Summary Report, 1910, p. 201.

Near *Wapoose lake in Leonard township*, a number of claims have been staked on a group of deposits of fine-grained magnetite. With the magnetite are associated banded silica rocks, jasper, and siderite. The principal ore-body outcrops along the apex of a ridge with strike approximately north and south, and it has been cross-cut by trenches at intervals of 40 feet for a distance of 1,900 feet. The ore-body maintains a fairly uniform thickness of about 40 feet, and dips towards the west at an angle of about 78°.

The principal ore outcrops were systematically sampled. The surface exploration and sampling indicate that there is undoubtedly a large tonnage of ore of the following average analysis:—

Iron.......	40·63 per cent	Lime	about	7·5 per cent
Silica......	15·43 „	Magnesia	„	4·0 „
Sulphur...	2·71 „	Manganese	„	2·25 „
Phosphorus	0·014 „			

References:—
G. R. McLaren for Lake Superior Corporation, Sault Ste. Marie, Ont., 1910.
W. H. Collins, Geol. Sur. Can., Summary Report, 1910, p. 201.
R. H. Flaherty, Port Arthur, Ont., 1911.

Mining Claims M.R. 3412 and 3414 are located about 1 mile northwest of the Wapoose Lake claims. The iron formation here consists of a band of chert agglomerate which is composed of elongated fragments of dark-grey chert in a dark-green felsitic matrix. An area of banded red jasper and brownish-grey chert lies next the agglomerate. Nothing of value has been shown up on the property.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ont., 1910.

Boston and Otto Townships.

About ½ mile east of Dane station on the Timiskaming and Northern Ontario Railway the *Boston Township Iron Range* is picked up and from there it extends east, and northeast almost to the northeast corner of Boston township, having a length of about 7 miles.

The iron formation consists of magnetite interbanded with jasper and other closely related siliceous material. The range has ben subjected to considerable disturbance by intrusions of igneous rocks. The width is not usually more than 90 to 100 feet, and the maximum width observed was 300 feet.

Reference:—
W. G. Miller, Ontario Bureau of Mines, 1905, p. 262.

In *Otto township* westward from Dane station, banded iron formation, composed of alternate bands of magnetite and silica, occurs at several points along the south edge of the Keewatin belt.

Reference:—
E. L. Bruce, Ontario Bureau of Mines, 1912, p. 256.

Englehart Area.

In *lots 1 and 2, con. V, Dack township* (about 2 miles west of Englehart station on the Timiskaming and Northern Ontario railway) two claims have been staked for iron. The country rock is greenstone. The iron prospect consists of a faulted zone with a maximum width of a few inches which has been filled with a mixture of calcite, lean reddish iron oxides, and hematite. The reddish oxides ramify back for a couple of feet from the fault zone as stringers and films in cracks in the greenstone. The property is valueless as an iron prospect.

References:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ont., 1910.
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ont., 1910.

Latchford Area.

On *Mountain lake*, 6 miles south of Latchford on the Timiskaming and Northern Ontario railway, a group of claims has been staked on showings of titaniferous magnetite.

Reference:—
L. L. Bolton for Lake Superior Corporation, Sault Ste. Marie, Ont., 1910.

IX. DISTRICT OF NIPISSING.

Timagami Lake Area.

Adjacent to the northeast arm of Lake Timagami, there are three iron ranges on which detailed geological work and a considerable amount of exploration work have been done. They are the *Northeast Arm range*, the *Vermilion range*, and the *Ko-ko-ko range*.

The iron formation in all these ranges consists of siliceous magnetite, interbanded with variously coloured jasper and chert. In some instances a small proportion of hematite is present, but this seldom exceeds 25% of the whole. Some of the richer ore-bands contain as high as 55% iron, but these are exceptions. The association of the magnetite and silica is extremely intimate, and even the richest bands of ore have a high silica content.

The *Northeast Arm range* has received the most attention and study. It is situated north of the northeast arm of Lake Timagami, its eastern end being only about ½ mile from Timagami station on the Timiskaming and Northern Ontario railway. It starts about one-tenth of a mile west of the north end of Crooked or Snake Island lake, and passing beneath the waters of Turtle lake, ends in a swamp about 14 chains from Tetapaga creek, having a total length of nearly 5¼ miles, with a width varying from 200 to 500 feet. (See maps Nos. 444 and 261).

The iron formation consists of siliceous magnetite, interbanded with variously coloured jasper and chert. The surrounding rocks are sericite and chlorite schists. The general strike of the formation is about N. 65° E. with a steep dip towards the north.

The following analyses represent average samples taken at various points along the range:—

Analyses of Iron Ore Samples from Northeast Arm Range.

Sample.	Iron.	Insoluble.	Notes.
I.	21·3%	68·7%	Width of outcrop 40 feet
II.	24·5%	64·2%	„ „ 30 „
III.	22·6%	66·2%	„ „ 35 „
IV.	27·2%	59·8%	„ „ 100 „
V.	18.6%	72·4%	„ „ 25 „
VI.	21.7%	66.9%	„ „ 45 „
VII.	24.2%	63.4%	„ „ 32 „
VIII.	23·2%	66·0%	„ „ 18 „
IX.	23.6%	63·3%	„ „ 32 „
X.	25·9%	59·3%	„ „ 36 „ T. B. Mine.
Average	23.3%	65.02%	

Some diamond drilling was done on this range in 1904 and 1905, but apparently no deposits of ore of merchantable grade were located.

Concentration experiments were made for the Ontario Bureau of Mines on a small shipment of the better class of material from this range, but the results do not seem to have been conclusive.

References:—
W. G. Miller, Ontario Bureau of Mines, 1901, p. 167.
A. E. Barlow, Geological Survey of Canada, Vol. XV, pp. 120–133 AA.
Ontario Bureau of Mines, 1905, pp. 31 and 78 A; 1906, p. 26A.
Geological Survey of Canada, Map No. 944, 1907.
Geo. C. Mackenzie, Ontario Bureau of Mines, 1908, pp. 272, 273.
E. Lindeman, Mines Branch, Summary Report, 1909, p. 67.

The Vermilion range lies about one mile north of the westerly half of the Northeast Arm range. It commences a little to the east of Vermilion lake, and runs in a southwesterly direction for about three miles to the west to Iron lake. To the northeast it is interrupted by a mass of greenstone, while the western end passes beneath the drift. It cannot extend much farther in this direction, as a tongue of granite comes in a short distance west of this lake. The widest portion, just south of Iron lake, measures over 1,000 feet.

The character of the iron formation is similar to that of the Northeast Arm range.

References:—
W. G. Miller, Ontario Bureau of Mines, 1901, pp. 169–171.
A. E. Barlow, Geological Survey of Canada, 1902–3, p. 126 AA.
Geological Survey of Canada, Map. No. 944, 1907.

The *Ko-ko-ko range* stretches $1\frac{3}{4}$ miles easterly from Ko-ko-ko lake to within 3 miles of the westerly end of the Vermilion range. This range is famous for the brilliancy of colour of the associated jaspers.

References:—
W. G. Miller, Ontario Bureau of Mines, 1901, pp. 171, 172.
A. E. Barlow, Geological Survey of Canada, 1902–3, p. 126 AA.
Geological Survey of Canada. Map No. 944, 1907.

Matagama point lies 12 miles southwest of Timagami station and is on the north side of the entrance to the Northeast Arm of Lake Timagami. Near the shore about a mile northeast of this point there are some large angular blocks of a dark chloritic rock with magnetite mixed through the mass in considerable proportion. Inland, some distance west of this, are some openings which were made about 1898 in a deposit consisting of magnetite and pyrite in a chloritic ground mass. From the openings the band was traced westward to a little bay which lies a short distance north of the house at the outermost part of Matagama point.

About a mile southwest of this house there is an outcrop of magnetite on the east side of *Timagami island* on which a little stripping has been done. Some large pieces of fairly pure magnetite were obtained here. The ore is coarse in grain and unlike that associated with the jasper in this area. The outcrop on the island seems to be a continuation of the band which runs out on Matagama point. An analysis of a sample of the magnetite from the island showed it to have the following composition:—

Iron	65·82	per cent.
Silica	3·60	"
Sulphur	0·096	"
Phosphorus	0·04	"
Manganese	Trace.	
Titanium	None.	

Reference:—
W. G. Miller, Ontario Bureau of Mines, 1901, pp. 168, 169.

Austin Bay Iron Range.

At the head of Austin bay, which forms the southern extremity of the south arm of Lake Timagami, there is a range of banded iron formation.

The most accessible outcrop lies close to the water's edge, somewhat east and south of the most western point of the bay. It shows on the northern face and on the top of a prominent hill which can be seen for some distance out in the lake.

The belt of iron formation on the hill is composed of thin bands of magnetite interlaminated with white and dark-coloured chert. It has a width of about 375 feet, and its strike is about west or slightly north of west with a dip of 50° northward. Going across the strike of the belt the needle dips strongly at three different points from 25 to 50 yards apart. Between these points the dip is slight, showing that certain parts of the belt are higher in magnetite than others. A short distance to the westward the belt is broken by the western extremity of the bay. West of this the jaspilyte rises into hills of considerable height. In parts of the belt here the magnetite is not abundant, and the dip of the needle is accordingly weak. This iron range has been traced westward with breaks at various points to some islands in the southwest arm of Lake Timigami, and in a southeastward direction from the head of Austin bay to a point near the southern end of Cross lake, being interrupted in places by intrusions of gabbro.

Reference:—
W. G. Miller, Ontario Bureau of Mines, 1901, pp. 174 and 175.

Emerald lake lies a few miles west of the southwest arm of Lake Timagami, and can be reached by way of a series of portages leading from this lake into Gull and other lakes. Banded iron formation is found along the eastern shore about half way up the lake. The band is of considerable width, and has been traced some distance back from the shore. The jaspilyte strikes the shore of the lake at a point along the south face of which there is a deep bay stretching to the east. Not far south of this point is the largest island in the lake, which rises to a considerable height. Jaspilyte outcrops in the northwest corner and runs inland. The magnetite here forms a high percentage of the rock and is quite massive. A pyritic band lies on each side of the jaspilyte.

No outcrops of iron formation were found on the western shore of the lake.

Reference:—
W. G. Miller, Ontario Bureau of Mines, 1901, p. 175.

Huron Mountain Property.

The Huron Mountain iron ore deposits are situated on the northwest shore of Manitopeepagee lake which lies approximately 35 miles southwest of Timagami station, and about 6 miles west of the southwest arm of Lake Timagami.

The iron ore occurrences are almost entirely confined to a hill 1,800 feet long and 700 feet wide. The magnetite occurs in the Keewatin iron formation, massive exposures of which flank both sides of the hill. Calcite and garnet are the most common accessory minerals associated with the iron ore. Calcite is also found in patches on both of the exposed ledges of the Keewatin formation. The segregations of ore appear to be of rather narrow width, and those of ore of good grade are few, and, generally speaking, the magnetite is mixed with calcite and rock. Analyses of 40 samples from surface exposures showed the following range in chemical composition:—

Iron	21·82% – 67·65%	Alumina	0·4% – 0·21%
Silica	4·71% – 16·16%	Lime	5·30% – 8·00%
Sulphur	None – 0·54%	Manganese	0·20% – 0·33%
Phosphorus	None – 0·022%		

The results of a magnetometric survey indicated that the ore deposits were very shallow, and diamond drilling done in 1908 and 1909 confirmed this supposition.

References:—
J. L. Coulson, for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1908.
B. F. Haanel, Mines Branch, Summary Report, 1908, p. 53.
F. G. Wait, Analyses of Ores and Minerals, Mines Branch, Ottawa, p. 59, 1909.
R. H. Flaherty, Port Arthur, Ontario, 1909.

Olrig Township.

In Olrig township, *W. C. Offer* has staked claims on a belt of crystalline limestone, portions of which are heavily impregnated with magnetite. The portions richest in magnetite are considered too low grade to be workable.

Reference:—
W. C. Offer, South Porcupine, Ontario, 1914.

Lake Nipissing Area.

On *Iron island*, about 25 miles west of North Bay, a little exploration has been done for iron. Crystalline limestone outcrops plentifully on the island, and in the limestone about half a dozen little pockets of hematite were observed, one of which measured 18 inches in its greatest horizontal dimension. The exceptional purity of the hematite in these pockets is probably the only reason that attention has been so often directed to them.

References:—
L. L. Bolton, for Lake Superior Corporation, Sault Ste. Marie, Ontario, 1909.
A. E. Barlow, Geol. Sur. Can., Vol. X, 1897, p. 150, I.

X. DISTRICT OF PARRY SOUND.

Township of Lount.

On *lot 136*, *concession B*, there are several outcrops of magnetite. Diamond drill exploration of the property was carried on in 1902, when three holes were drilled to depths of 29, 31, and 74 feet respectively. The holes cut several veins or bands of ore, for the most part of narrow width.

On *lot 137*, *concession B*, a drill hole put down in 1902 to a depth of 50 feet in search of iron ore cut only hornblende and mica schist.

On *lot 32*, *concession VIII*, reported occurrences of magnetite were explored by diamond drill in 1902. Two holes were drilled to depths of 51 and 30 feet respectively. The formation drilled consisted of hornblende gneiss and hornblende schist. In each hole a narrow vein of magnetite was cut, but the magnetite deposits were found to be very limited in length and depth.

Reference:—
Ontario Bureau of Mines, 1903, pp. 50 and 51.

Magnetawan Mine.

This property covers lots 16 and 17, concession III, and the mining rights of lots 125, 126 and 127, concession A, in the township of Lount, and is reached by a 14-mile road northwesterly from Sundridge station on the Grand Trunk railway.

Some prospecting work was carried on in 1901, and an open trench cut along an ore-body for a distance of 50 feet. The average width of the trench is 10 feet, and the depth ranges from 12 to 22 feet. From the trench about 500 tons of ore have been taken out. Exploratory work was also done on some of the other lots, on which several exposures of magnetite are reported.

The formation is a dark green to black garnetiferous diorite, in which occur bodies of magnetite, the strike, dip, and other characteristics of which are, however, not determinable on account of the small amount of work yet done. The developed body is apparently a lens trending north and south, about 10 feet wide, consisting in places of practically clean ore and in places intermixed with dark green hornblende, which also lines the walls.

Reference:—
W. E. H. Carter, Ontario Bureau of Mines, 1902, p. 262.

Over a large *area in concessions XII, XIII, and XIV* pockets of magnetite occur plentifully, but no deposit of ore of encouraging size has been located.

References:—
P. A. Gough for R. H. Flaherty, Port Arthur, Ontario, 1903.
H. E. Knobel for R. H. Flaherty, Port Arthur, Ontario, 1903.

XI. DISTRICT OF HALIBURTON.

Township of Lutterworth.

The *Paxton Mine* property comprises lot 5, concession V, and lot 5, concession VI. The mine is located about 2½ miles from Kinmount on the Haliburton branch of the Grand Trunk railway. A considerable amount of ore is reported to have been shipped from this mine, but the mine has not been operated for many years.

The ore is magnetite and occurs in a fine-grained gneiss interstratified with crystalline limestone and amphibolites. The ore-body is irregular in width. In one of the main workings it was as much as 35 feet across. This ore-body, however, is not all magnetite, but consists largely of various dark iron-bearing silicates, garnet, pyroxene, etc., with which the magnetite is mingled.

Reference:—
Adams and Barlow, Memoir No. 6, Geol. Survey of Canada, p. 356.

Township of Snowdon.

The *Victoria mine* is located on lot 20, concession I, and is within half a mile of the Irondale, Bancroft and Ottawa railway. Prior to 1882, it was worked quite extensively, and a considerable tonnage of ore was shipped from it. The ore is magnetite, and it contains a rather large admixture of dark iron-bearing silicates, and has a not inconsiderable amount of pyrrhotite scattered through it.

In 1893, the workings consisted of a trench 240 feet long and about 16 feet wide. The ore lies in crystalline limestone which is occasionally interstratified with pyroxene rock, red garnet rock and gneiss. The ore-body is 7 feet wide at the northern end of the trench, but at the southern end the ore has been practically all replaced by black hornblende and other highly ferruginous silicates.

The following is the result of an analysis of the ore, by Chapman, (probably a selected specimen):—

Ferric oxide	58·35	per cent.
Ferrous oxide	24·87	„
Manganese oxide	0·13	„
Alumina	0·42	„
Lime	1·43	„
Magnesia	2·56	„
Phosphorus	0·07	„
Sulphur	0·04	„
Silica	11·17	„
Titanium dioxide	0·73	„
Metallic iron	60·19	„

Reference:—
Adams and Barlow, Geol. Survey of Canada, Memoir No. 6, p. 359.

On *lots 25, 26, and 27, concession IV*, near Howland station, on the Irondale, Bancroft and Ottawa railway, there are several outcrops of magnetite. The deposit at the *Howland mine* on lot 26 lies at the contact of a hornblende gneiss and a narrow band of limestone.

The principal working consists of a shaft which has been sunk to a depth of 75 feet on an outcrop of magnetite about 25 feet in diameter. At a depth of 25 feet the work was enlarged by extension towards the walls in the form of an ellipse, the longer axis of which was about 65 feet, and the shorter about 35 feet. This stope was opened from the 25-foot to the 50-foot level, and no wall was encountered. The best ore ranged from 55 to 60 per cent in iron, 0·005 phosphorus and 0·06 sulphur; 1,500 tons of ore were shipped in 1881 and 1882.

References:—
C. J. Pusey, Report of the Ontario Royal Commission, p. 131.
Adams and Barlow, Memoir No. 6, Geol. Survey of Canada, p. 361.

The *Imperial mine*, lot 23, concession V, is situated on the north side of the Irondale, Bancroft and Ottawa railway, close to the track and just east of Irondale station. The material taken out as ore is composed essentially of olivine and augite, with a smaller amount of hornblende and feldspar. Only a very few grains of iron ore occur scattered through the rock.

Reference:—
Adams and Barlow, Memoir No. 6, Geol. Survey of Canada, p. 262.

Township of Glamorgan.

On *lots 29, 30, and 32, concession I*, small stringers of magnetite are found in amphibolite, but the thickest have a width of only 6 inches.

Reference:—
Adams and Barlow, Geol. Survey of Canada, Memoir No. 6, p. 354.

At *Pine lake, lot 35, concession IV*, a large deposit of granular magnetite forms a ledge or succession of ledges rising to a height of 80 to 100 feet above the general level of the district. It is exposed for a length of 1800 feet, and has a width varying from 70 to 198 feet. A partial analysis of a sample taken from different parts of the deposit is given herewith:—

Iron	52·04	per cent.
Sulphur	0·06	"
Phosphorus	Trace.	
Titanium dioxide	13·30	"

Reference:—
Adams and Barlow, Geol. Survey of Canada, Memoir No. 6, p. 353.

Exposures of magnetite have been found on *lot 27, concession XIII*, and magnetic attraction is reported to be very strong over an area 400 feet long and 40 feet wide.

Reference:—
Adams and Barlow, Geol. Survey of Canada, Memoir No. 6, p. 35.

On *lot 27, concession XV*, there are several iron-bearing veins, the largest of which has a maximum width of 4 feet, and can be traced for 60 yards. Magnetite constitutes about 50 per cent of the principal vein, but the *quantity* is entirely too small to permit of the deposit being considered as a source of iron.

Reference:—
Adams and Barlow, Geol. Survey of Canada, Memoir No. 6, p. 352.

Township of Monmouth.

On *lot 30, concession XIII*, a deposit of magnetite with high iron content is reported.

Reference:—
W. G. Miller, Ontario Bureau of Mines, 1899, p. 202.

XII. COUNTY OF PETERBOROUGH.

Township of Anstruther.

Claims have been taken up for iron on the south halves of lots 26 and 27, concession XV, about 9 miles south of Tory Hill station on the Irondale, Bancroft and Ottawa railway.

The owners claim the existence of an ore-bearing zone 1,600 feet long by 200 feet wide, in which there occur bands of ore with widths up to 15 feet. Two shafts have been sunk in ore to a depth of 25 feet. The following analyses have been furnished:—

	Surface Ore.	Ore Depth 10′	Ore Depth 25′
Iron..............	47·00%	52·25%	52·05%
Silica..............	......	......	20·52%
Sulphur...........	0·15%	Nil.	0·57%
Phosphorus........	0·03%	......	0·024%
Titanium..........	Nil.	Nil.	......

Reference:—
S. Lawrence for P. J. Dwyer, 91 Medland Crescent, Toronto, Ont., 1914.

Township of Chandos.

On *lot 28*, *concession I*, an open-cut, 53 by 21 feet, has been made into a hill, exposing a dark-coloured amphibolite, associated with some magnetite. Magnetic indications of several other deposits in the immediate vicinity were also noticed, but they all appeared to be of very small extent.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 14, Mines Branch, Ottawa, No. 184, 1913.

Township of Belmont.

Blairton Mine (*Lots 7 and 8*, *Concession I*).
(See Vol. I.)

Belmont (*or Ledyard*) *Mine* (*Lot 19*, *Concession I*).
(See Vol. I.)

XIII. COUNTY OF HASTINGS.

Township of Carlow.

Kennedy Property, (*Lot 17*, *Concession V*).

The Kennedy property lies about 1½ miles northeast of Boulter P.O., and may be reached by wagon road from L'Amable station on the Central Ontario railway, the distance being about 22 miles.

The area is heavily drift-covered. The formation is made up of coarse-grained mica granite, intruding limestone and amphibolites.

A body of magnetite has been exposed by a surface stripping 182 feet long and 10 to 34 feet wide. An average sample taken across the ore-body gave the following analysis:—

Iron	43·70	per cent.
Insoluble	10·50	"
Sulphur	0·020	"
Phosphorus	0·118	"

The general trend of the ore-body is N. 25° W. It lies embedded in the granite and is cut in its southern part by a pegmatite dike, 3 feet in width.

Judging from the magnetometric survey, the ore-body has a total length of about 220 feet. (See maps 193 and 193A). A short distance farther north the magnetic survey indicates the presence of another ore-body of somewhat smaller extent and completely covered by drift. On the *Allison farm*, about 850 feet southwest of the main working, two strong magnetic areas can be seen on the map. The larger strikes in a northwest-southwest direction and has an approximate length of about 200 feet. Both are totally covered by drift.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 21, Mines Branch, Ottawa, No. 184, 1913.

On lot 17, concession VII, north of the Kennedy property, a strong but very irregular magnetic attraction indicates the presence of several detached small ore-bodies. Two small outcrops of magnetite and several isolated exposures of white crystalline limestone and amphibolite, apparently inclusions in a large granite intrusive, were observed on this lot.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 22, Mines Branch, Ottawa, No. 184, 1913.

Township of Faraday.

On the west side of Bow lake on *N. ½ lot 21, concession X*, and the *S. ½ lot 21, concession XI*, several outcrops of magnetite have been found. The distance east to Bancroft on the Central Ontario railway by wagon road is about 6 miles.

The rock formation of the area is to a great extent made up of a coarse-grained red granite, the chief constituents of which are a pink feldspar with some hornblende and quartz. Other rocks of the area are crystalline limestone and amphibolites forming smaller or larger inclusions in the granite.

The magnetite, associated with mica, chlorite, apatite, and hornblende, occurs along the contact of the limestone with the granite. There is a rather strong magnetic attraction along the west slope of a hill trending north and south on lot 21, con. XI. (See map No. 194). Several open-cuts and test-pits have been made along the hill, but none of these workings has revealed any ore-body of sufficient size to be of economic importance. An average sample of the ore gave the following analysis:—

Iron	51·0% per cent.
Silica	9·03 „
Sulphur	0·070 „
Phosphorus	1·94 „

Farther south on both sides of the line between concessions X and XI, a strong but irregular attraction is found in several places. (See map No. 194).

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 22, Mines Branch, Ottawa, No. 184, 1913.

Township of Dungannon.

On the south side of a ridge running east and west on *lot 30, concession XIII*, an open-cut has been made exposing a coarse-grained granite, with some magnetite in narrow bands. The ore is of good character, as shown by the following analysis, but the extent of the ore-body is very limited, the magnetic attraction being weak only a few feet from the exposure of magnetite.

Iron	67·67 per cent.
Silica	1·20 „
Sulphur	0·011 „
Phosphorus	0·042 „

References:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 22, Mines Branch, Ottawa, No. 184, 1913.

Adams and Barlow, Geological Survey of Canada, Memoir No. 6, p. 351.

Township of Mayo.

Bessemer Mine (See Vol. I.)

Rankin Property (*Lot 10, Concession IX*).

Here considerable stripping has been done exposing magnetite associated with hornblende and chlorite schist over an area of 300 feet long and 68 feet wide. A magnetometric survey indicates the possibility of other ore-bodies existing on the property. (See maps 192 and 192A, Vol. I.)

An analysis of an average sample of the ore exposed in the open-cut is given herewith:—

Iron	42·70 per cent.
Silica	15·87 "
Sulphur	0·215 "
Phosphorus	0·104 "
Lime	8·08 "
Magnesia	1·74 "
Titanium	0·10 "

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, pp. 19-21, Mines Branch, Ottawa, No. 184, 1913.

Child's Property (*Lots 11 and 12, Con. IX*). (See Vol. I.)

Stevens Property (*Lot 13, Concession IX*).

On this property a number of test pits and strippings have been made. Judging from the magnetometric survey the ore deposits on this lot are of an extremely irregular character, an inference which is well confirmed by the work done. (See maps 192 and 192A, Vol. I.)

The character of the ore is indicated by the following analysis of an average sample of the ore exposed:—

Iron	30·70 per cent.
Insoluble	23·00 "
Sulphur	0·015 "
Phosphorus	0·080 "

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, pp. 19-21. Mines Branch, Ottawa, No. 184, 1913.

Township of Wollaston.

Ridge Property.

The property referred to under this name is situated near Ridge post-office, about 4½ miles south of Coehill, and includes lots 17 and 18, con. III, and lots 16 and 17, con. II, of Wollaston township. The area is heavily drift-covered, and the only exposure of magnetite so far found is situated on lot 17, con. II. Here a thin band of magnetite, lying in mica and hornblende schist, has been revealed by stripping at the foot of the hill. Farther up the hillside, a metamorphic rock, chiefly made up of garnet, is seen in contact with the same schist.

On lot 18, con. III, a test-pit is reported to have been sunk through clay to a depth of 27 feet, without reaching bed-rock.

The magnetometric survey shows that there is a considerable magnetic attraction on this property, extending in an east and west direction for about half a mile. On this stretch several detached areas are found, which have a magnetic attraction of 60 degrees or more. The two largest occupy a total area of about 74,000 square feet, and seem to warrant further investigation in the form of diamond drilling. (See map 189).

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 16, Mines Branch, Ottawa, No. 184, 1913.

Coehill Mine (Lots 15 and 16, Con. VIII). (See Vol. I.)

Jenkins Mine (Lots 17 and 18, Con. VIII).

The Jenkins property adjoins the Coehill property to the east. Most of the area is drift-covered, and the iron-bearing formation has been exposed in only a few places. The main work has been done on lot 18, and consists of a shallow open-pit, 180 feet long, with a maximum width of about 40 feet. Some magnetite, associated with hornblende and pyroxene, is exposed in this pit. Ore of similar character has also been exposed in several other pits and strippings.

The following analyses represent two average samples taken across the exposed ore-bodies:—

	I.	II.
Iron........................	46·08%	49·50%
Insoluble..................	35·30%	34·20%
Sulphur....................	0·52%	0·28%
Phosphorus...............	0·054%	0·036%

Sample No. 1 was taken from the main pit on lot 18, while No. 2 comes from one of the pits on lot 17.

The magnetic attraction of the area is very irregular, changing within small areas from strong positive to strong negative intensity, indicating an irregular and pockety distribution of the magnetite in the country rock. This is well confirmed by the open-pit on lot 18. (See maps Nos. 190 and 190A).

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 15, Mines Branch, Ottawa, No. 184, 1913.

On *lots 9 and 10, concession XV*, there is a large intrusion of gabbro-diorite through which is disseminated a little titaniferous magnetite. The occurrence is of no economic interest.

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 23, Mines Branch, Ottawa, No. 184, 1913.

Township of Lake.

A body of magnetite is found along the line between *lot 18, concession III, and lot 18, concession IV*, about 200 yards east of the Deer river. The ore can be traced along the river bank for a distance of over 200 yards. A width of six feet of nearly pure ore is exposed in one place, and a width of $3\frac{1}{2}$ feet in another. The ore occurs in an amphibolite schist. A specimen of the ore was found to contain 60·09 per cent of metallic iron and to be free from titanic acid.

Reference:—
Adams and Barlow, Memoir No. 6, Geological Survey of Canada, p. 355.

East of Whetstone lake, on *lots 19 and 20, concession IV*, small patches of magnetite are found associated with amphibolite. Several openings have been made along a ridge running north and south without revealing any ore-body of economic importance.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 16, Mines Branch, Ottawa, No. 184, 1913.

On *lot 17, concession XI*, some prospecting has been done on several small patches of titaniferous magnetite associated with gabbro-diorite. An average sample taken from one of the workings gave the following analysis:—

Iron	52·40 per cent.
Insoluble	25·25 „
Sulphur	0·034 „
Phosphorus	0·012 „
Titanium	15·31 „

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 23, Mines Branch, Ottawa, No. 184, 1913.

Township of Tudor.

Orton Mine.

On lot 57, west of Hastings road, stripping and trenching has been done on a few deposits of titaniferous magnetite, which occur at the western end of the lot near the boundary line between the townships of Lake and Tudor. The magnetite occurs in a gabbro-diorite into which it seems to gradually merge. (See map No. 405). An average sample taken by Lindeman, gave the following analysis:—

Iron	46·60 per cent.
Insoluble	29·00 „
Sulphur	0·06 „
Phosphorus	0·020 „
Titanium	10·00 „

In 1912 a small tonnage of ore was mined and shipments to Belleville, for experiments in electric smelting being carried on there by Mr. J. W. Evans, were made in 1912 and 1913.

References:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 23, Mines Branch, Ottawa, No. 184, 1913.
E. T. Corkill, Ontario Bureau of Mines, 1913, p. 135.
A. H. A. Robinson, Mines Branch Summary Report, 1915, p. 37.

Ricketts Iron Mine.

Magnetic iron ore is exposed in several places on lot 17, concession XI. About six pits have been sunk for testing purposes. These pits were supposed to lie on the strike of the ore formation, and were believed to tap the iron ore of one continuous body.

When the underlying rock is exposed, it is seen in places to be banded with iron ore. These bands are very narrow and much contorted, and the ore appears to be too lean even for concentrating purposes.

Magnetic observations taken systematically over the area showed that the ore did not occur as one continuous body but in a number of pockets. The chances of there being any deposits of economic interest seem small.

Reference:—
B. F. Haanel, Mines Branch, Summary Report, 1909, p. 114.

St. Charles Mine. (Lot 19, Concession XI).

The St. Charles mine is situated on lot 19, concession XI, about half a mile west of McDonald siding on the Central Ontario railway. The ore is magnetite, associated with more or less gangue matter consisting of garnet, hornblende, pyroxene, and calcite. It occurs along the contact of crystalline limestone with a medium to fine-grained diorite. There are, according to the magnetometric survey, three deposits in the property. On the principal deposit pits Nos. 1 and 2 have been made. Strong magnetic disturbances exist along the hillside for a distance of 320 feet. The total area within which magnetite is likely to occur is roughly estimated at 13,500 square feet. (See maps Nos. 187 and 187A). A considerable portion of this area however, contains ore which is either too low in iron or too high in sulphur to be suitable for iron smelting without previous concentration.

An average sample taken across the ore-body at opening No. 2 gave the following analysis:—

Iron	42·00	per cent.
Insoluble	31·85	„
Sulphur	0·832	„
Phosphorus	0·080	„

During the season of 1900, 3,000 tons of ore are reported to have been shipped from this property to the Hamilton blast furnace. The iron content of this ore varied from 57 to 60 per cent, while the sulphur ranged from 0·5 to 1 per cent.

References:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 13, Mines Branch, Ottawa, No. 184, 1913.
C. de Kalb, Ontario Bureau of Mines, 1900, p. 128.
W. E. H. Carter, Ontario Bureau of Mines, 1901, p. 261.

On the east side of a ridge running approximately north and south on *lot 8*, *concession XV*, several strippings have been made showing a grey granite in contact with chlorite and hornblende schist. Associated with the schist are narrow bands of magnetite. The magnetic attraction is rather strong in places, but none of the workings have so far revealed any ore-body of sufficient size to be of economic importance.

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 14. Mines Branch, Ottawa, No. 184, 1913.

Baker Mine.

The Baker mine is situated on lot 18, concession XVIII, about $1\frac{1}{4}$ miles west of Gilmour station, on the Central Ontario railway.

The workings consist of three open-cuts and a number of test-pits on the eastern slope of a ridge running north and south. The ore is a fine-grained magnetite, intermixed with a large amount of gangue matter, chiefly pyroxene and chlorite. It occurs along the contact of crystalline limestone and diorite. Iron pyrites is of common occurrence in the diorite as well as throughout the ore. Judging from the magnetometric survey the ore occurs in small detached bodies or pockets. (See maps 188 and 188A). The largest area of strong magnetic attraction is found around open-cut No. 1. The development work done here has, however, so far failed to reveal any ore of economic importance. The ore-body opened up by open-cut No. 2 has a width of about 25 feet, but the magnetometric survey indicates that its extent is very small. Working No. 3 shows another small pocket of magnetite along the contact of limestone and diorite.

An average sample taken across the ore-body at open-cut No. 2 gave the following results:—

Iron	38·70	per cent.
Insoluble	37·10	"
Sulphur	3·35	"
Phosphorus	0·20	"

Reference:—

E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 13. Mines Branch, Ottawa, No. 184, 1913.

Emily Mine.

The Emily mine is situated on lot 7, concession XIX, about $1\frac{3}{4}$ miles northeast of Gilmour station. Chapman, in the transactions of the Royal Society of Canada, 1885, section III, p. 12, describes this as a magnetic ore deposit of considerable extent. He says: "The exposed ore rises in a series of ledges from the level of the ground to a height of from 150 to 180 feet, and extends over a space of at least 1,000 feet in length by 100 feet in breadth." This could not be verified by Lindeman. On lot 7 a somewhat abrupt ridge, chiefly made up of a coarse-grained granite, was found. A large open-cut had been made into the hillside, showing in places some small patches of magnetite heavily intermixed with gangue matter. The magnetic attraction around the open-cut is also very irregular.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 14, Mines Branch, Ottawa, No. 184, 1913.

Township of Marmora.

The greater part of lots 12, 13, and 14, concession I, is occupied by a coarse-grained gabbro-diorite, cut in the most intricate manner by a red granite and pegmatites. Along the contact with the latter rocks magnetite in small quantities is found in several places disseminated through the gabbro-diorite. Where the magnetite has been found, the magnetic attraction is, however, very feeble and the discoveries so far made are of no economic importance.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 12, Mines Branch, Ottawa, No. 184, 1913.

On *lot 18, concession I,* (*Maloney mine*), a few hundred feet south of the Ontario, Belmont, and Northern railway, a deposit of magnetite has been exposed. The workings consist of two open-pits and a stripping. Between the three workings a magnetic attraction exists for a distance of about 280 feet. The ore-body, as exposed in the main pit, shows a width of about 25 feet. It consists of magnetite mixed with a considerable amount of gangue minerals. An average sample of the ore taken by Lindeman, gave the following analysis:—

Iron	47·00	per cent.
Insoluble	21·03	"
Sulphur	0·50	"
Phosphorus	0·137	"
Titanium	0·250	"

On the hill immediately south of the workings, numerous outcrops of gabbro-diorite can be seen, while an outcrop of crystalline limestone was observed near the railway track to the north.

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 11, Mines Branch, Ottawa, No. 184, 1913.

On a hill running east and west, on *lot 17, concession II*, two test-pits have been sunk about 150 feet apart, showing some magnetite disseminated throughout a gabbro-diorite similar in character to that seen on the Maloney property. The distance from the workings to the Ontario, Belmont, and Northern railway is about 500 feet.

An average sample of the iron-bearing rock gave the following analysis:—

Iron	34·80	per cent.
Insoluble	43·80	"
Sulphur	0·41	"
Phosphorus	0·134	"
Titanium	0·10	"

Reference:—
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, Mines Branch, Ottawa, No. 184, 1913.

Township of Madoc.

The *Seymour mine* was one of the earliest producers of iron ore in the district, but has been abandoned for many years. It is located on the west half of lot 11, concession V, about 4 miles north of the village of Madoc. The old shaft is said to be 125 feet deep.

The old open-cut has a length of about 200 feet with a width ranging from 18 to 25 feet. The ore consists of a fine-grained magnetite, associated with chlorite, pyroxene, and hornblende. It is surrounded by a large granite eruptive. The magnetic attraction near the workings is very weak.

References:—
C. De Kalb, Ontario Bureau of Mines, 1901, p. 129.
E. Lindeman, Magnetite Occurrences along the Central Ontario Railway, p. 12, Mines Branch, Ottawa, No. 184, 1913.

The *Wallbridge mine* is situated on lot 12, concession V. A considerable amount of hematite is reported to have been shipped from this mine, but no accurate information is available. The mine apparently was last operated in 1900.

Reference:—
C. De Kalb, Ontario Bureau of Mines, 1901, p. 129.

The *Brennan mine*, located on lot 7, concession VI, was in operation in 1901 when 250 tons of hematite were shipped to the blast furnace at Radnor Forges, Quebec. Work was confined to the surface and consisted merely of stripping and trenching without exposing any large body of hematite.

Reference:—
W. E. H. Carter, Ontario Bureau of Mines, 1902, p. 262.

Exploratory operations are known to have been carried on at the following properties, and from some of them ore shipments have been made, but no accurate information concerning these operations is available:—

Cook and Thompson mine, (lot 15, concession V).
St. Charles mine (lot 4, concession VI).
Cameron mine (lot 9, concession VI).
49-Acre mine (lot 10, concession VI).
Miller mine (lot 12, concession VI).
Sexsmith mine (lot 8, concession VII).
Farrell mine (lot 9, concession VII).

XIV. COUNTY OF RENFREW.

Township of Grattan.

On the *Parks property*, lot 16, concession VIII, outcrops of banded ore formation in gneiss can be traced for 1300 feet. In some places the ore-band is 50 feet wide. It is reported that the ore carried too high a percentage of titanium to be attractive to furnace men.

Reference:—
P. A. Gough and W. W. J. Croze for R. H. Flaherty, Port Arthur, Ont.

The ore deposits on lot 16, concession IX, are known as *Radnor mine*. The distance from the mine to Caldwell station on the Ottawa-Parry Sound branch of the Grand Trunk railway is six miles, and the wagon haul to the shipping siding is 4¼ miles.

The ore, which is a coarse-grained granular magnetite, occurs in rather narrow lenses varying in maximum thickness from 4 to 25 feet. The ore-lenses are found in line for a distance of about 1300 feet, the series of outcrops forming roughly a semicircle towards the centre of which the ore horizon dips at an angle of about 35°. The country rock is a biotite gneiss, and this is cut by pegmatite dikes, a few of which cut the ore-lenses too.

A small amount of diamond drill work was done in 1900 and 1904, but the results offered no encouragement for expecting any large tonnage of ore.

The ore-lenses outcropping on surface were exploited by open-pit methods of mining which necessarily became very expensive at depth, because of the fairly flat dip of the ore-bodies; eight pits were operated.

The mine operated almost continuously from 1901 to 1907, during which time there were shipped approximately 18,824 net tons of ore, all of which went to Radnor Forges, Quebec. Shipping ore had an iron content of 48 per cent and upwards; all leaner ore was left in stock at the mine.

Magnetic concentration experiments on the low grade ores gave very favourable results.

References:—
E. T. Corkill, Ontario Bureau of Mines, 1905, p. 71.
G. C. Mackenzie, Ontario Bureau of Mines, 1908, p. 220.
G. C. Mackenzie, Ontario Bureau of Mines, 1910, p. 169.
R. W. Ells, Geological Survey of Canada, Vol. XIV, p. 65J.

On the *Big Jim property,* ot 17, concession X, there are occurrences of magnetite similar to those at Radnor mine, but after a little exploration in 1902 the property was abandoned.

Reference:—
W. E. H. Carter, Ontario Bureau of Mines, 1903, p. 114.

Township of Brougham.

On *lots 7 and 8, concession X*, there are some six-inch seams of granular magnetite in a contact zone between granitic gneiss and crystalline limestone. The ore is of good quality, but the quantity is too small to be of interest.

Reference:—
D. B. Rockwell for R. H. Flaherty, Port Arthur, Ontario, 1910.

On *lot 14, concession XVIII*, near Dacre, a deposit of magnetite was worked in 1901.

Reference:—
R. W. Ells, Geological Survey of Canada, Vol. XIV, p. 64 J.

Township of Blithfield.

On *lot 13, concession I*, about three miles south of Calabogie, in a side rock-cut on the Kingston and Pembroke railway, a vein of magnetite, dipping at 35° to the east, is exposed for a length of about 75 feet, and for a height of 8 feet, without the foot-wall being shown.

The face of the rock-cut is a little over 50 feet high, with a rising hill to the east. On this hill the magnetic attraction is weak; but numerous readings taken along the edge of the swamp to the west of the railway, and in some places as much as 200 feet from it, varied from −17 to −22 degrees.

More readings could not be taken on account of the swamp.

An average sample of the exposed portion of the vein gives the following analysis:—

Iron	38·80	per cent.
Insoluble	37·40	"
Sulphur	0·179	"
Phosphorus	0·013	"
Titanic acid	4·96	"

Reference:—
H. Fréchette, Summary Report of Mines Branch, 1909, p. 86.

Township of Bagot.

The magnetometric survey was made on parts of lot 23, concession V, and lot 23, concession VI, where some prospecting had been done.

The readings indicate the presence of a number of small bodies of magnetite, dipping very slightly to the south, the maximum thickness being about 6 feet.

A sample taken from various parts of these deposits gives the following analysis:—

Insoluble	37·08 per cent.
Iron	31·02 „
Sulphur	0·167 „
Phosphorus	0·312 „

On *lot 28, concession VI*, to the southeast side of the road which runs through that lot, a pit has been sunk to a depth of 18 feet in magnetite. The ore is found in alternating layers of high grade magnetite and a gneissic rock carrying magnetite. It dips to the south at about 15°. In the pit the ore is exposed for a thickness of eight feet, but the foot-wall was not uncovered.

About 100 feet to the east of the pit there is a mass of gneiss; and to the north, a large exposure of crystalline limestone.

No magnetometric survey was made.

The following analysis is from an average sample taken in the pit:—

Iron	42·81 per cent.
Insoluble	38·00 „
Sulphur	0·068 „
Phosphorus	0·006 „
Titanic acid	1·37 „

Reference:—
H. Fréchette, Summary Report of Mines Branch, 1909, p. 86.

Culhane Mine.

The Culhane mine is situated on lot 21, concession VII. It lies on the south shore of Norway lake, about three miles northeast of Calabogie station. Magnetite occurs here in small irregular bands or lenses in a series of crystalline limestones, interbedded with amphibolite schist. The general strike of the iron-bearing formation is northeast with a dip of 30 degrees towards the northwest. There are four workings on the property, the locations of which are shown on magnetometric map No. 252. This map shows that the most promising area lies in the northeast part of the field, immediately south of reference post No. 40. At this point a small open-cut about 35 feet long and 10 feet wide has been made into the hillside, exposing some limestone interbanded with amphibolites. From the bottom of this cut a vertical shaft has been sunk in search for ore, but evidently with negative results. A small amount of magnetite, disseminated throughout the schists, is probably the cause of the strong magnetic attraction found here.

About 250 feet southwest of the last mentioned open-cut lies the main shaft, 70 feet deep, from which a few hundred tons of ore have been extracted and piled up nearby. At its mouth some magnetite intermixed with hornblende and mica schist is exposed, but judging from the irregular magnetic attraction there is no prospect of finding any ore-body of importance here.

Working No. 3 consists of an open-cut exposing a schistose amphibolite, through which a small amount of magnetite is disseminated.

No ore has been shipped from this mine.

References:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 62–I.
E. Lindeman, Magnetite Occurrences near Calabogie, p. 15, Mines Branch, Ottawa, No. 254, 1914.
T. B. Caldwell, Lanark, Ontario, 1915.

Campbell, or No. 4 Mine.

The workings known as the Campbell, or No. 4 mine, are situated on lot 16, concession VIII, close to the "T.B." pit of the Caldwell mine to be described later, and are about 1½ miles east of Calabogie village on the Kingston and Pembroke railway.

The workings consist of an open-cut 100 by 40 feet and three test pits, exposing dark coloured amphibolites, with considerable mica and chlorite. The magnetic attraction of this area is very irregular, indicating a pockety distribution of the magnetite in the country rock. (See map No. 249).

References:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 60–I.
E. Lindeman, Magnetite Occurrences near Calabogie, p. 14, Mines Branch, Ottawa, No. 254, 1914.

Caldwell Mine.

The Caldwell mine is situated on the east half of lot 16, concession IX, about one mile east of Calabogie station.

Work was begun on this property in 1883, and subsequently a number of openings were made by the Hamilton Steel and Iron Company, who carried on mining operations for a short time. The total amount of ore shipped from the property is reported to have been 10,000 tons. The greater portion of this went to the blast furnace at Hamilton. An average analysis of a shipment of seven cars to that point is given herewith:—

Iron	58·30	per cent.
Silica	5·47	„
Sulphur	Trace.	„
Phosphorus	0·137	„
Alumina	3·68	„
Lime	2·03	„
Magnesia	0·15	„

The railway freight to Hamilton was $1.80 per gross ton.

The ore consists of a medium-grained magnetite which occurs in small irregular masses or lenses, associated with a dark-coloured, basic, highly schistose amphibolite, composed chiefly of feldspar, hornblende and biotite. The general strike of the iron-bearing rocks is northeast and southwest, and the dip about 40° towards the southeast.

There are a great number of open-cuts and test-pits on this property, the locations of which are shown on magnetometric map No. 249, accompanying this report. The Tommy R pit is an open-pit and trench extending about 110 feet with a width ranging from 15 to 45 feet. The iron-bearing formation revealed by this working consists of bands of magnetite interbanded with amphibolite schists, through which individual grains of magnetite often are disseminated. The average iron content of the ore in this pit is, therefore, rather low. The following analysis represents a sample taken by Lindeman across the exposure:—

Iron	38·30	per cent.
Insoluble	16·10	„
Sulphur	0·02	„
Phosphorus	0·233	„

From 500 to 900 feet northeast of the Tommy R pit, several small deposits of magnetite have been revealed by numerous pits and trenches. They all lie in a dark-coloured amphibolite schist with which they are often found interbanded. In some instances the contacts with the adjacent amphibolites are sharp, and the ore of an exceedingly good quality, but in many cases the ore and the country rock grade imperceptibly into each other. The width of the richer ore layers ranges from 2 to 7 feet, while their length is rarely more than 150 feet, and usually less.

A sample taken across one of these deposits gave the following analysis:—

Iron	60·91	per cent.
Silica	4·60	„
Sulphur	0·10	„
Phosphorus	0·575	„
Alumina	3·60	„
Lime	1·77	„
Magnesia	2·83	„

The T. B. pit is an irregular open working about 90 by 80 feet, and reported to be 60 feet deep. Dark-coloured amphibolites associated with mica and small particles of magnetite are exposed in the upper portion of the pit.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XVI, p. 58–I.
E. Lindeman, Magnetite Occurrences near Calabogie, p. 13, Mines Branch, Ottawa, No. 254, 1914.
T. B. Caldwell, Lanark, Ontario, 1915.

On the *west half of lot 16, concession IX*, a shallow pit has been sunk at the edge of a beaver meadow exposing some magnetite associated with amphibolites. A sample from an ore-pile near the pit gave the following analysis:—

Iron	47·81	per cent.
Silica	15·00	„
Sulphur	0·015	„
Phosphorus	0·390	„
Alumina	3·85	„
Lime	4·86	„
Magnesia	7·05	„

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 57–I.
E. Lindeman, Magnetite Occurrences near Calabogie, Mines Branch, Ottawa, No. 254, 1914.

On *lot 18*, *concession IX*, about one mile northeast of Calabogie village several pits have been sunk showing a vein of magnetite varying from 1½ to 3 feet in thickness. With the magnetite there is mixed a little hematite. The vein is enclosed in crystalline limestone. Magnetic attraction in the vicinity is very feeble.

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 85.

Martel, or Wilson Mine.

The Martel, or Wilson mine is situated on lot 15, concession X, about 1¾ miles southeast of the village of Calabogie. In a flat of low ground two openings have been made about 350 feet apart.

The principal mining operations have been confined to Pit No. 1 (See map No. 253). From this pit 2,000 tons of good magnetite are reported to have been extracted and shipped. Pit No. 2 is a mere prospect hole. The ore, judging from what little shows above water around the edge of pit No. 1, occurs in a dark green, almost black, diorite. Lindeman's magnetometric map shows the magnetic attraction to be very irregular, and gives little encouragement for finding any ore-body of importance. 4,000 tons of ore are reported to have been shipped from this mine.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 61–I.
E. Lindeman, Magnetite Occurrences near Calabogie, p. 15, Mines Branch, Ottawa, No. 254, 1914.

Bluff Point Mine.

The Bluff Point mine is situated on lot 16, concession X, and lot 16, concession XI, on the northeast side of Calabogie lake, and about one mile south of Calabogie village. The old workings are connected with the main line of the Kingston-Pembroke railway by a spur line about three-quarters of a mile in length.

The magnetite occurs in irregularly-shaped lenses along the contact of crystalline limestone and a dark grey amphibolite. The general strike is northeast-southwest, with a dip ranging from 30 to 45 degrees towards the southeast.

The workings consist of three shafts and several open-cuts. The deepest shaft is 300 feet, and in one of the open-cuts, magnetite is exposed showing a width of 4 feet.

The following analysis represents a shipment of ore made by the Canada Iron Furnace Company:—

Iron	59·50 per cent.
Silica	9·10 „
Sulphur	0·16 „
Phosphorus	0·17 „
Alumina	4·80 „
Lime	0·01 „

It may be seen from magnetometric map No. 251 that the strong magnetic attraction is confined to a few small areas around pits Nos. 1, 2, 4, and 5, indicating a very pockety distribution of the ore, none of the ore-bodies being 100 feet in length.

Mining operations were commenced at Bluff point in 1881, but closed in 1883; resumed in 1886, but again discontinued the following year. In 1894 a few shipments of ore were made from stock piles to Radnor, Quebec, by the Canada Iron Furnace Company.

The following years a small amount of mining was done, but since 1901 the property has been idle.

The total amount of ore shipped from Bluff point and Campbell mines is reported to have been about 9,000 tons.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 55–I.
E. Lindeman, Magnetite Occurrences near Calabogie, Mines Branch, Ottawa, No. 254, 1914.

On *lot 18, concession XI*, magnetic disturbance was observed near the main road which follows the west shore of Calabogie lake.

A magnetometric survey was made which indicates the existence of magnetite in a series of small pockets extending for about 600 feet along the road and crossing it.

Reference:—
H. Fréchette, Summary Report of Mines Branch, 1909, p. 85.

Williams, or Black Bay Mine.

This mine is situated on lot 22, concession XI, about 2 miles northwest of Calabogie village.

The magnetite occurs along the contact of crystalline limestone and a basic amphibolite. The general strike is about northeast-southwest, with a dip, judging from the inclination of the workings, of about 40 degrees towards the northwest. The limestone forms the foot-wall, and is found to the south of the working, while the amphibolite lies to the north.

The proved length of the deposit in the main working is about 240 feet, but towards both ends of the pit, the ore-body becomes indefinite, the orey ground being represented by amphibolite containing some disseminated magnetite. The open-cut has a face of about 15 feet, beyond which the ore has been followed downward in several inclines along the dip. The depths of these inclines are reported by Mr. E. D. Ingall to vary from 10 to 80 feet.

A sample taken from an ore pile gave the following analysis:—

Iron...............................	51·50 per cent.
Insoluble...........................	15·85 „

Judging from the magnetometric survey the prospects of finding any ore-body of importance on this property are not encouraging. (See map No. 250).

Shipments of 25,000 tons of ore are reported to have been made from this mine to Cleveland, Ohio.

References:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 64–I.
E. Lindeman, Magnetite Occurrences near Calabogie, p. 16, Mines Branch, Ottawa, No. 254, 1914.
T. B. Caldwell, Lanark, Ontario, 1915.

Township of McNab.

McNab mine. In 1873 or 1874 a small deposit of hematite in crystalline limestone, situated about three-quarters of a mile west of the town of Arnprior, on lot 6, concession XIII, of the township of McNab, and known as the McNab mine, was worked for about a year by the Peter Bell Iron Company of Boston.

Some 10,000 to 15,000 tons of ore, carrying about 68 per cent iron, a little phosphorus, and no sulphur or titanium, are said to have been mined.

Subsequently, some exploratory work was done by different parties.

Reference:—

Report of the Royal Commission on the Mineral Resources of Ontario, 1890, p. 141.

XV. COUNTY OF FRONTENAC.

Township of South Canonto.

On the south end of *lot 26, concession VI*, a pit has been opened on a vein of magnetite. An outcrop near the pit shows the ore to be fairly free from intermixed rock. A sample taken from a small ore pile near the pit gave the following analysis:—

Iron	44·00 per cent.
Insoluble	31·60 „
Sulphur	0·044 „
Phosphorus	0·045 „
Lime	0·70 „
Magnanese	0·10 „
Titanic acid	Trace.

The vein, which runs north and south, was traced by means of a mining compass for about 350 feet into lot 26, concession V. The width of the vein appears to be about 10 feet.

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 87.

Township of Palmerston.

Mississippi or Robertsville Mine, and Mary Mine.

On an iron-bearing area about one mile northeast of Robertsville station on the Kingston and Pembroke railway are located the Mississippi, or Robertsville mine (lot 3, concession IX), and the Mary mine (lot 4, concession IX). A spur about a mile in length connects the workings with the railway.

The rock immediately enclosing the ore is a dark, compact, heavy basic rock, probably diorite. The magnetite is found intermixed through the rock, in irregular patches, in veinlets, and as scattered grains. In some of the workings there are ore-pockets which would yield a considerable tonnage of ore, but about 50% of the surface exposed in the workings is said to be gangue matter.

Eight workings are described by Ingall, who made examinations of the property in 1895 and 1900. The largest is a pit 108 feet long and 200 feet deep, which has a width of 50 feet in places.

A series of dip needle readings taken systematically over the property showed no particular attraction except in the immediate vicinity of the main pit and betweeen pits Nos. 7 and 8.

A number of diamond drill holes have been put down, but the records of these are not available.

Since 1895 the mines have been idle, but prior to that date 6,000 to 7,000 tons of ore are reported to have been shipped.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 29–I.

About a mile west of Lavant station on the Kingston and Pembroke railway, on *lots 27 and 28, concession XI*, a little work has been done on an occurrence of magnetite. The magnetite occurs in bands of various thicknesses at the contact of limestone and grey gneiss. Actinolite and chlorite are of frequent occurrence in the ore.

Reference:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 32-I.

Township of Bedford.

On lot 5, concession II, across a bay of Thirty Island lake from the Glendower mine, there is a small prospect pit from which some magnetite has been extracted. An exposure of ore 25 feet long and 15 feet wide may be seen in the pit, but nothing definite seems to have been proven about the extent of the ore-body. A little pile of ore standing beside the pit shows a considerable proportion of intermixed foreign material, amongst which are calcite and considerable pyrite.

Reference:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 27-I.

Glendower Mine.

The mine is situated within four miles of Bedford station on the Kingston and Pembroke railway, with which point it is connected by a branch line. The main workings are on lot 6, concession II, and lot 6, concession III.

The ore-bodies developed on the workings are in gneissic rocks, immediately at or near their contact with a belt of crystalline limestone.

Pit No. 1 was the principal working. At its entrance a shaft with a reported depth of 180 feet was sunk. A considerable tonnage of ore is said to have been extracted from it. On the surface the ore-body thins out as it is followed west. At No. 2 pit a shaft of unknown depth was sunk. No tonnage of good ore remains exposed at either pits 1 or 2, or at any other pit. At pit No. 9 there is an ore-body consisting of magnetite and apatite in about equal proportions, from which a small tonnage was shipped to meet a demand for phosphatic ore from the Hamilton smelter.

A number of diamond drill holes were put down subsequent to the closing of the mine and prior to 1895. Data concerning these holes furnished Mr. Ingall indicated the existence of a rib of ore 20 to 30 feet thick, but of undetermined length, and a great deal of intermixed magnetite and gangue matter. Dip needle readings taken do not seem to have furnished any conclusive indications of ore-bodies.

The mine was first operated prior to 1873 by the owners, and from 1873 to 1880 by the Glendower Company. The Zanesville Company, which acquired the property about 1883, built the railway spur to the mine, and operated the mine for four or five years. In 1895 the mine had been idle for several years. In 1899 the Hamilton Steel and Iron Company mined and shipped a little ore. The total shipments to 1895 are estimated to have been about 50,000 tons.

The Glendower Company is reported to have shipped no ore running less than 60% iron, but the Zanesville Company is said to have disposed of 50 per cent ore. The earlier shipments are said to have been reasonably free from sulphur, but the later ones, coming from depths greater than 180 feet, are said to have had an objectionable percentage of it. A pile of several hundred tons lying at No. 1 shaft in 1895 showed the ore to contain a considerable proportion of calcite and pyrite.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 20–I.

On lot 3, concession III, there is a large area of gneiss in which are impregnations of magnetite and isolated bodies of magnetite of varying size and quality. A diamond drill hole was put down 300 feet to explore the ground, but the results were unfavourable.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 29–I.
E. Lindeman, Report of Superintendent of Mines, Ottawa, 1907, p. 33.

Black Lake Mine.

About a mile and a half northeast from the main workings of the Glendower mine, on lots 7 and 8, concession IV, are situated the Black Lake deposits.

Deposit No. 1 occurs on a small peninsula at the south end of the lake. A few small cuts have been made here, and the faces of these show a dark green hornblende rock with impregnations of magnetite and calcite. The magnetic survey shows that the deposit is of very small extent.

Deposit No. 2 occurs on an island close to the west shore of the lake. An open-cut has been dug here and some ore is said to have been taken out. Magnetite and iron pyrite are seen distributed through the rock formation and the decomposition of the latter gives the rock a rusty and rotted appearance.

Deposit No. 3 occurs on another island about 900 feet northeast of deposit No. 2, and is of the same nature as the two former. The rock is, however, not so much altered. None of the deposits are of economic value.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 28–I.
E. Lindeman, Summary Report of the Superintendent of Mines for 1907, p. 32.

On lot 2, concession VII, north of Birch lake, and at a few other points in the neighbourhood are patches of ochreous sandstone, with small veins and stringers of hematite, either in the sandstone itself or in the underlying limestone. The quantity of ore in every case is too small to be of economic interest.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 76–I.

On *lots 1 and 2, concession XIV, lots 1, 2, and 3, concession XV, and lots 1, 2 3, and 4, concession XVI*, near Lake Opinicon, there are small pockets of hematite in cavities in limestone. All are too small to be of economic interest. Two drill holes put down in 1900 gave unfavourable results.

Reference:—
J. Kellerschon for R. H. Flaherty, Port Arthur, Ontario.

Township of Portland.

Smith Lands.

On the Smith lands, lot 5, concession XIII, numerous test-pits were made, and two diamond drill holes put down. The test pits showed small pockets of ore in cavities in limestone, but the drilling gave unsatisfactory results.

Reference:—
J. Kellerschon for R. H. Flaherty, Port Arthur, Ontario, 1900.

XVI. COUNTY OF LANARK.

Township of Lavant.

Radenhurst and Caldwell Mines.

These properties comprise the west half of lot 22, concession III, and the east half of lot 22, concession IV, and they are located close to the Kingston and Pembroke railway about a mile north of Flower station.

The development consists of a number of pits and strippings spread over a distance of about 3,000 feet on a general E.N.E. and W.S.W. direction. The dip is to the south and varies from 60 to 70 degrees. The rocks consist of rusty schists and gneisses of various compositions. Limestone occurs a short distance west of the outcrops on lot 22, concession IV.

The ore occurs as small seams and ribs of magnetite associated with chlorite and rusty schistose rocks. The ribs and seams are generally parallel to the strike of the enclosing rock.

A concentrating test made at the Mines Branch Ore Dressing Laboratories, on a small shipment of ore taken from one of the old dumps, gave very encouraging results.

A magnetometric survey of the property indicates that the ore-bearing formation has a length of about 2,300 feet in concession III, and about 1,200 feet in concession IV; the total area within which magnetite is likely to occur is about 250,000 square feet. (See map No. 446).

Judging from the general rustiness of the rock and from the evidence of the ore-piles, pyrites must be plentiful.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 52–I.
T. B. Caldwell, Lanark, Ontario, 1915.
G. C. Mackenzie, Mines Branch, Summary Report, 1914.
A. H. A. Robinson, Mines Branch, Summary Report, 1916.

Wilbur Mine.

The Wilbur mine workings are located on lot 4, concession XII, and lot 4, concession XIII, a short distance east of the Kingston and Pembroke railway, with which they are connected by a spur about a mile long.

Nine different openings are to be seen on the property. With the exception of No. 3, however, these have all been long abandoned and nothing worthy of special description can be seen at them. Judging by the dumps, several of them must have been of considerable extent.

The magnetite occurs as a series of detached ore-bodies in gneissic rocks at their contact with underlying limestone. The chain of ore-bodies has a general trend of about northeast, while the dip of the formation and of the workings on the ore, is to the south at angles varying from 25 to 40 degrees. The contact between the gneiss and the limestone at the western pits is fairly sharply defined, but in the vicinity of the eastern pits the two series of rocks seem to be separated by an alteration zone in which chlorite, epidote, etc., are found, evidently alteration products of the gneiss.

Judging from a magnetometric survey made by B. F. Haanel, the ore deposits are extremely pockety. (See map No. 441).

A very considerable amount of diamond drilling was done on the property prior to 1900, but the records of none of this work are available.

The mine was first opened up many years ago, and was worked for several years under lease by the Kingston and Pembroke Mining Company, during which time shipments of 125,000 tons are reported to have been made. In 1901 the mine was developed by the owner, the leases having lapsed. In 1907 the Wilbur Iron Ore Company leased the property, and during 1907 and 1908 shipped 21,892 tons of ore to the Algoma Steel Company, Sault Ste. Marie. After being closed down for a couple of years the mine was reopened in 1910 by the Hawthorne Silver and Iron Mines Company, but no shipments were made.

References:—

E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 461.
B. F. Haanel, Report of Superintendent of Mines, Ottawa, 1906, p. 5.
E. T. Corkhill, Ontario Bureau of Mines, 1907, p. 86.
E. T. Corkhill, Ontario Bureau of Mines, 1911, p. 108.
R. H. Flaherty, Port Arthur, Ontario.

Township of Darling.

At the northeast end of lot 17, concession II, amphibolites are found which are impregnated in a great many places with magnetite in varying proportions. Occasionally the rock is rich enough in magnetite to be described as a lean ore. At the west end of the hill magnetometric readings indicate the presence of a fairly large and continuous body of low grade ore, which would require magnetic concentration. No satisfactory sample could be obtained at this point. The iron would probably run about 30 per cent.

Reference:—
H. Fréchette, Summary Report of the Mines Branch, 1909, p. 85.

Southwest of the Darling road, on the southwest half of lot 22, concession III, and along the north side of a hill, there are a number of large trenches which were opened about twenty years ago, and from which ore was shipped. These trenches have caved in and trees are now growing in the bottom of some of them. No reliable information could be obtained regarding the extent of the ore.

Magnetometric readings taken in the vicinity of these trenches were low and irregular, and do not indicate the presence of a large body of magnetite.

On the opposite side of the Darling road, on the northeast half of the same lot, a pit was recently opened on a small pocket of magnetite.

Reference:—
H. Fréchette, Summary Report of Mines Branch, 1909, p. 85.

On *lot 20, concession IV, and lot 20, concession V*, the amphibolite rocks are impregnated with magnetite. The magnetometric survey shows the impregnations to be very irregular. The deposits are not considered of economic importance. A surface sample gave the following analysis:—

Iron	24·21 per cent.
Insoluble	53·00 "
Sulphur	0·031 "
Phosphorus	0·468 "

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 85.

On *lot 22, concession IV*, several pits have been opened on small pockets of magnetite, and some shipments of ore made therefrom; but, judging from the magnetometric readings these deposits cannot be considered of any importance.

Reference:—
H. Fréchette, Mines Branch Summary Report, 1909, p. 84.

On *lot 22, concession V*, a pit has been sunk about 20 feet into a small pocket of fine-grained magnetite. A picked sample of the magnetite gave the following analysis:—

Iron	61·17 per cent.
Insoluble	8·34 "
Sulphur	0·042 "
Phosphorus	0·046 "

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 85.

Yuill Mine.

The Yuill mine is located on lot 25, concession V. The workings consist of an open-pit 100 feet long, 30 to 40 feet wide, and a little over 70 feet deep. At the east end of the pit the magnetite band is 6 feet wide, and at the west end it is 10 feet wide. The ore dips steeply to the south, having a foot-wall of diorite and schist and a hanging wall of crystalline limestone. Small veins of pyrite occur in the ore. A sample of ore exposed in the workings and on the dumps gave the following analysis:—

Iron	63·00 per cent.
Insoluble	10·08 „
Sulphur	0·006 „
Phosphorus	0·025 „

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 83.

On *lot 23, concession XI* there is exposed a deposit of hematite 30 to 35 feet long and 2 feet wide. An average sample gave the following analysis:—

Iron	62·52 per cent.
Insoluble	3·20 „
Sulphur	0·004 „
Phosphorus	0·44 „

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 83.

Fahey Mine.

The Fahey mine is located on lot 26, concession XI, about 1,000 feet east of White lake. The workings consist of a shaft 20 feet deep and a few trenches, all of which are on a hematite vein. The ore deposit is exposed in one place from wall to wall, showing a width of 15 feet. Both walls are crystalline limestone. A sample from an ore-pile gave the following analysis:—

Iron	34·73 per cent.
Insoluble	2·44 „
Sulphur	0·054 „
Phosphorus	0·029 „
Lime	20·30 „
Magnesia	3·44 „
Manganese	0·32 „

Reference:—
H. Fréchette, Mines Branch, Summary Report, 1909, p. 82.

Township of Dalhousie.

Playfair, or Dalhousie, Mine.

The Playfair mine is situated on lot 1, concession IV. The mine was opened in 1866, and between 1870 and 1873 it is reported that 11,100 tons of good ore were shipped to United States points.

The ore deposit was a lens-shaped body of hematite which showed a tendency to thin out both in length and depth. The total length of the excavation was about 500 feet, and for about half the distance at the eastern end the main body was paralleled by a smaller one, the two being separated by a wall of limestone 5 to 10 feet in thickness. The greatest thickness of the smaller lens was about 7 feet, and it seems to have thinned out to nothing both in length and depth. The enclosing country rock is crystalline limestone.

The following analysis by the Geological Survey gives the composition of the ore:—

Iron	57·6	per cent.
Insoluble	16·05	„
Phosphorus	0·026	„

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 70.

Township of South Sherbrooke.

Bygrove Mine.

The Bygrove mine is located on lot 3, concession I. The only development work done at this place consists of a pit about 40 feet long by 20 feet wide and 25 feet deep. The pit is now full of water to within 10 feet of the top.

The ore to be seen in the walls of the upper parts of this pit consists of magnetite in irregular and apparently not very persistent ribs, varying from an inch or two to a little over a foot in thickness. The ribs thin out rapidly in places, and come in in other places in a very erratic manner. Blasts put into the outcrops along a length of about 50 feet show magnetite occurring in the same irregular way as in the pit. Pyrite is present but not in very large quantities.

To the south of the pit for some distance there is a considerable development of acid gneiss. To the northward definite outcrops of solid rock are infrequent; there are, however, no signs of limestone, for some distance. The walls of the pit show a rather rotten brownish gneissic rock.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 32.

Fournier Mine.

The Fournier mine is located on lot 14, concession I. The workings consist of five pits and other openings. The ore is magnetite and the deposits are found in an area of dark-coloured basic gneiss. The mode of occurrence is in irregular ribs, veins and pockets. Apparently the proportion of ore recoverable from the tonnage of material extracted was too small for economic operations.

The last attempt at operation was made in 1873, when a shaft was sunk 110 feet, and about 600 tons of good ore were raised. No analyses of the ore are available.

Magnetic readings taken systematically with the dip needle showed magnetic disturbances only in the immediate vicinity of the pits, or at those points where ore was already known to exist.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 34.

Christie's Lake Mine.

This property comprises lots 18, 19, and 20, concession III on the north shore of Christie's lake.

The country rock is a dark-coloured gneiss through which magnetite occurs disseminated in small grains and concentrated in small pockets and long narrow lenses. The greatest thickness of ore reported is 7 feet, and the greatest length 200 feet.

A number of dip needle readings were taken, and these showed magnetic disturbance only in the immediate vicinity of the pits.

Analyses of four samples taken in 1906 by W. S. Johnson are given herewith:—

	Stripping No. 1.	Stripping No. 2.	Stripping No. 4.	Stripping No. 5.
Iron............	60·57%	61·32%	60·29%	59·13%
Sulphur........	4·47%	0·12%	0·206%	0·55%
Phosphorus.....	0·004%	0·008%	0·009%	0·003%
Titanium dioxide	0·87%	1·74%	1·39%	1·04%

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 37.
W. S. Johnson for D. W. Ogilvie and Company, Montreal, Que., 1906.

Silver Lake Mine.

On lot 16, concession IV, on the east shore of Silver lake there are two pits, and several shallow workings between, known locally as Silver Lake mine.

The main, or more northerly pit is a small cut made in a dark compact hornblende rock, and very little magnetite is to be seen in place.

The second pit is about 100 yards southerly from the main pit. Here an exposure of dark crystalline hornblende, reticulated with ribs and veins of magnetite, occurs.

Dip needle readings showed strong attraction south of the main pit. Between it and the southerly pit there are some evidences at one or two points of possible occurrences of magnetite. Elsewhere no attraction out of the normal was found.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 41.

Ritchie Mine.

On lot 16, concession VII, are some workings known as Ritchie mine. A small test-pit shows magnetite in narrow bands at the north and south ends. The ore-bands apparently follow the strike of the enclosing gneissic rock and dip to the south. Both here and at another pit the magnetite is mixed with gangue matter comprising calcite, mica, hornblende, etc. A picked specimen of magnetite had an iron content of 67·6%, but the average percentage of iron in any considerable tonnage would be low.

Reference:
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 42.

Morran Mine.

The Morran mine is located on lot 13, concession VIII, about 1 mile distant from the Ritchie mine.

The country rock is a dark-coloured gneiss containing small pockets, and disseminations of magnetite. Apparently no quantity of interest of merchantable ore was exposed in the workings.

The following is the analysis of a picked specimen of ore reported to come from this lot:—

Iron	68·43	per cent.
Silica	2·79	"
Sulphur	0·067	"
Alumina	0·189	"
Magnesia	0·38	"
Manganese	0·26	"

Magnetite of similar grade and of similar mode of occurrence outcrops frequently for a distance of two miles to the west.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 43.
A. B. Rudd, Perth, Ontario, 1914.

Township of Bathurst.

Lots 10 and 11, concession VIII, are known as the *Foley mine* property. The property was operated years ago, when, apparently all the ore exposed was removed.

As far as could be ascertained the deposits consisted of an aggregate of magnetite, hornblende, apatite and pyrite.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 45.

XVII. COUNTY OF LEEDS.

Township of North Crosby.

The *Matthews mine* is located on the north shore of Mud lake, on lot 1, concession VI, about one mile from the village of Newboro on the

Brockville division of the Canadian Northern railway. Shipping facilities by the Rideau canal, of which Mud lake forms a link, are also available.

The ore-bodies consist of irregular segregations of titaniferous magnetite in a coarse-grained gabbro-gneiss. A magnetometric survey indicated the existence of a considerable quantity of ore to the south and southwest of the ore-body, which was exploited by a pit 300 feet long and 100 feet wide.

Mining operations date from 1860. During 1871 upwards of 4,000 tons of ore were raised, of which 3,300 tons were shipped via boat to Cleveland, Ohio. There is no information available concerning any operations subsequent to that time.

References:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 66.
B. F. Haanel, Mines Branch, Summary Report, 1909, p. 112.

The *Allan prospect*, on lot 27, concession IV, shows magnetite in small veins and ribs in a dark basic rock.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 36.

Township of South Crosby.

The *Chaffey mine* is located on an island in Mud lake, which is a part of lot 27, concession VI. It is about half a mile south of the Matthews mine. Shipping facilities are available over the Canadian Northern railway, passing within a mile of the property, and via the Rideau canal to the Great Lakes.

As at the Matthews mine the ore is a titaniferous magnetite, and the ore-bodies seem to be isolated irregularly shaped segregations in a coarse basic rock, probably gabbro. Three ore-bodies have been exploited by open pits, probably pretty thoroughly. A magnetometric survey indicates the existence of some ore unexplored as yet.

The following is an analysis by the Geological Survey of Canada of Chaffey mine ore:—

Iron	50·23	per cent.
Silica	7·10	„
Sulphur	1·52	„
Phosphorus	0·085	„
Alumina	5·65	„
Titanium dioxide	9·80	„

The mine was operated in 1858 and 1859, during which time about 6,000 tons of ore were shipped to Pittsburgh, Pa. Shipments in 1870 and 1871 to Cleveland, Ohio, were apparently about 11,000 tons. Of operations subsequent to 1871 there is no information available.

Reference:—
E. D. Ingall, Geol. Survey of Canada, Annual Report, Vol. XII, p. 66.

QUEBEC.

LIST OF OCCURRENCES INVESTIGATED.

I.

QUEBEC.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED.

MAGNETITE AND HEMATITE.

Argenteuil County.

GRENVILLE TOWNSHIP.

Occurrences of magnetite have been known since 1846 on *lot 3, range V*, township of Grenville. They are found in gneiss and hornblende schist forming small pockets 1 to 2 feet in diameter. Similar occurrences are reported on *lot 3, range IV* and on *lot 4, range VII*.

Reference:—

Cirkel, Report on the Iron Ore Deposits along the Ottawa a
No. 23, Mines Branch, Ottawa.

Compton County.

SPALDING TOWNSHIP.

Some prospecting for iron ore has been carried on in the vicinity of Spalding village on *lots 10 and 11 of range VIII*, Spalding township.

The rock is a quartzite impregnated with grains of magnetite and hematite, which in some cases are concentrated along the joint planes. The greatest length of moderately mineralized rock is about 15 feet. The workings consist of numerous scattered shallow trenches, none of which show any ore-body of economic importance. The alleged ore is high in manganese as shown by the following analysis:—

Iron	18·00	per cent.
Silica	54·47	"
Manganese	5·123	"
Sulphur	0·60	"
Phosphorus	0·05	"

A magnetometric survey of the property by B. F. Haanel confirms the pockety character of the ore.

References:—

Dulieux, Report on Mining Operations in the Province of Quebec for 1912, p. 105.
A. W. G. Wilson, Mines Branch, Summary Report, 1909, p. 79.

Gaspe County.

On several occasions occurrences of iron ore have been reported in Gaspé peninsula, but so far no discovery of economic importance has been made. Near Newport Centre, Gaspé, and in Bonaventure county, veins of siliceous hematite are found in Cambro-Silurian schists, but are quite insignificant in quantity.

References:—

Dulieux, Report on Mining Operations in Quebec for 1912, p. 120.
R. E. Lenthall, Newport Centre, Gaspé Co., Que., 1915.

Megantic County.

LEEDS MINE.

This mine is on lots 7a and 7b of range V, Leeds township, and is reached by wagon road from Robertson station on the Quebec Central railway, the distance being about 14 miles.

Such ore as has been found occurs in small lenses intercalated in Pre-Cambrian schists usually chloritic. On lot 7b a number of outcrops of siliceous ore can be seen and on lot 7a, two or three trenches have followed lenses of magnetite which reach a maximum thickness of 4 to 5 feet, and 60 to 80 feet in length. A magnetometric survey by B. F. Haanel confirms the pockety character of the ore, and gives no encouragement of finding any ore-body of economic importance.

The average value in iron of the lenses ranges from 45 to 55 per cent of metallic iron, with a very low phosphorus and sulphur content.

References:—
Dulieux, Report on Mining Operations in Quebec for 1912, p. 100.
B. F. Haanel, Summary Report of Mines Branch, Department of Mines, 1905, p. 110.

Ottawa County.

BALDWIN MINE.

This name is given to a series of small excavations on lot 13, range VI of Hull township, about 1,000 feet from the Forsyth mine.

Magnetite occurs in isolated pockets in crystalline limestone, gneiss and amphibolites, but no ore mass of any extent has been uncovered by these excavations. A magnetometric survey made by E. Nystrom confirms the pockety character of these deposits. (See map No. 439). The deposits are of no economic importance.

References:—
Dulieux, Report on Mining Operations in Quebec for 1912, p. 119.

FORSYTH MINE.

The Forsyth mine is on lot 11, range VII, Hull township, about 5 miles northwest of the city of Hull.

The first mining operations date back to 1845-46, when some ore was shipped to Cleveland. In 1855 about 5,000 tons of ore are reported to have been shipped and another shipment of 8,000 tons was made in 1858. In 1867 a blast furnace was built at the mine which was in operation that year and part of 1868. Its daily production was 6·5 tons.

The main working consists of an open-cut about 700 feet long, 40 to 70 feet wide, with a depth of from 25 to 50 feet. This open-cut was made on a lens of magnetite in crystalline limestone. The whole width of the open-cut is not all in magnetite. Of some 40 feet of exposed width there is but 15 feet of ore, which is found in 3 beds with widths of 8, 5, and 2 feet respectively. The ore is predominantly a magnetite with small quantities of hematite. The iron content of the ore varies from 53 to 60 per cent, with silica ranging from 11 to 20 per cent. Phosphorus runs from 0·014 to 0·027 and sulphur from 0·089 to 0·044.

Diamond drilling is reported to have proven the existence of ore-bodies which would yield 430,000 tons of concentrates (R. H. Flaherty) of the following analysis:—

Iron	57·29 per cent.
Silica	10·67 "
Sulphur	0·62 "
Phosphorus	0·017 "
Lime	1·47 "

References:—
F. Cirkel, Mines Branch, Ottawa, Publication No. 23, pp. 37–49.
R. H. Flaherty, Port Arthur, Ontario.

Haycock Mine.

This mine is situated on lot 28, range VI, Templeton township. Mining operations were started in 1873, and continued with few interruptions until the autumn of the following year. A charcoal furnace was also erected. It appears, however, that while the quality of the ore was excellent, the quantity necessary to keep the furnace in operation was lacking. Since 1874 the property has been lying idle. Small pockets and narrow veins of excellent hematite with a considerable percentage of magnetite are found in places along the stratification lines of the gneiss. They are not commercially important.

Reference:—
F. Cirkel, Mines Branch, Ottawa, Publication No. 23, pp. 60–67.

Pontiac County.

There are quite a number of deposits known to occur throughout the county of Pontiac, but as far as known they are all of too limited extent to be of commercial value.

Such occurrences are reported on—

Lot	2, range	I,	Bristol	township.
"	22, "	I,	"	"
"	25, "	II,	Clarendon	"
"	27, "	VII,	"	"
"	12, "	I,	Litchfield	"
"	12, "	V,	"	"
"	10, "	VIII,	"	"
"	13, "	VII,	Calumet	"
"	2, "	IX,		
"	4 and 5 "	X,	Litchfield	"
"	12 and 13 "	VI,	Sheen	"

Reference:—
Cirkel, Report on the Iron Ore Deposits along the Ottawa and Gatineau Rivers, No. 23, Mines Branch, Ottawa.

Bristol Mine. (See Vol. I.)

II.

TITANIFEROUS MAGNETITE.

Numerous deposits of titaniferous magnetite are found at various localities throughout the Province of Quebec. They occur in gabbro and anorthosite, and are considered to be basic segregations of these magmas.

Beauce County.

BEAUCEVILLE.

These deposits have been uncovered by some small workings on a line 3 miles long between the *Plante and Gallway rivers*, two tributaries flowing into the Chaudière river.

Some excavations and trenches have been made on lots 301 and 302 of the *St. Charles Range*, which is reached by wagon road from Beauceville station on the Quebec Central railway. In one of the workings a lens of magnetite 10 to 12 feet wide can be seen, grading gradually into the country rock, while in most of the other pits no ore worth mentioning was found.

The analysis of the ore is as follows:—

Metallic iron	54·77%
Titanium	7·49%

Reference:—
Dulieux, Report on Mining Operations in the Province of Quebec for 1912, pp. 94-100.

BLOCK MINE.

This mine is situated about 500 feet from the line separating the Ste. Corinne range from the Block range. It is reached by wagon road from Beauceville station on the Quebec Central railway, the distance being about 5½ miles.

The workings consist of a series of shallow trenches showing the ore (magnetite) to occur in small irregular pockets and stringers in a serpentine rock. The total area within which such pockets occur is 110 by 40 feet.

Some of the ore-pockets are chromiferous, and others are not, as is indicated by the following analyses:—

Iron	43·06 per cent.	47·7 per cent.
Chrome	6·80 „	None.
Titanium	0·09 „	9·79 „

Reference:—
Dulieux, Report on Mining Operations in the Province of Quebec during the year 1912, p. 95.

Lake St. John County.

Alma island lies at the outlet of Lake St. John, dividing the Saguenay river into 2 branches.

On lot 36, range II, 800 feet north of the road crossing this island from east to west, is a series of small lenses of titaniferous magnetite in a coarse-grained anorthosite, the largest exposed outcrop being 15 by 30 feet. A sample of the ore gave the following analysis:—

Metallic iron..........................53·07 per cent.
Titanium...............................11·94 „

The deposits are considered to be of no importance.

Reference:—
Dulieux, Report on Mining Operations in Quebec for 1912, p. 93.

The *Kenogami deposits* are in range II of Kenogami township on the line of the Quebec Canadian Northern railway between Ratière station (mile 213) and that of Larouche, (mile 205), the latter being formerly called Kenogami station. They are reached by wagon road from Ratière station, the distance being 4 miles.

The workings show small masses of titaniferous magnetite in anorthosite, and are of no economic importance. A sample taken of the richer portion of the ore gave:—

Metallic iron..........................53·07 per cent.
„ titanium..............................12·47 „

Reference:—
Dulieux, Report on Mining Operations in Quebec for 1912, p. 91.

The *St. Charles deposits* are on lot 44, range 1, Bourget township, about 1½ miles to the west of St. Charles village. They can be reached by wagon road either from Jonquière or Herbertsville stations on the Quebec and Lake St. John railway (C.N.R.), the distance being 15 miles in a straight line from the railway.

The ore is a titaniferous magnetite and occurs in anorthosite. Outcrops of ore can be traced along the foot of a hill bordering on the Saguenay river for about 700 feet, with a minimum width of 160 feet in the central part.

North of these several other outcrops of ore can be seen, one of which exceeds 300 feet in length and 20 feet in width. The probable ore quantity of the area is estimated by Dulieux to be at *least 5,000,000 tons*.

The following table gives analysis of the ore and results of concentration tests:—

Crude Ore:—Composition {Iron — 50·53 per cent. / Titanium — 10·55 „}

Ore before treatment.					Percentage of magnetic concentrates.	Percentage of tailings.	Concentrates and tailings. Analyses.	
	Fe.	Ti.	S.	P.			Fe.	Ti.
A—From 20 to 40 mesh 39·40%......	52·97	9·32	0·020	0·21	72.24	25·86	57·50 35·67	6·51 17·66
B—From 40 to 80 mesh 34·28%......	52·05	12·01	0·018	0·026	77·00	23·00	59·68 31·00	9·39 21·59
C—Smaller than 80 mesh 26·32........	44·40	11·36	0·012	0·050	82.00	17·40	50·02 21·02	0·36 21·14

Loss, 0·6 per cent.

Reference:—
Dulieux, Report on Mining Operations in Quebec for 1912, pp. 85–90.

Saguenay County.

Seven Islands.

There are several deposits of titaniferous magnetites near the bay of Seven Islands on the north shore of the St. Lawrence. On the river Rapide within four miles of its mouth there are three deposits known as the *Cran de Fer Falls deposit* or *Molson Mine*, the *Outarde Falls deposit*, and the *Gagnon deposit*.

The Cran de Fer Falls deposit was referred to by Dr. Sterry Hunt, in the Report of the Geological Survey for 1866-69 and in several Dominion and Provincial Reports since that date. Dulieux defines the deposit as "a very large mass of a titaniferous magnetic iron containing in its pure parts from 50 to 52 per cent of metallic iron and from 12 to 15 per cent of titanium. The rock immediately associated with this ore is a fine-grained gabbro charged with titano-magnetite, frequently to such an extent that it might pass for iron ore itself."

"Any estimate of the tonnage can be but a guess, from what may be seen in the outcroppings in the vicinity of the falls it may be put at a minimum of from 300,000 to 400,000 tons of rich ore. It is reasonable to suppose that the real tonnage is much higher."

The Gagnon and Outarde deposits in the same vicinity consist of masses of black gabbro rich in magnetite which could be worked only on a basis of crushing and concentration.

Reference:—
Dulieux, Report on Mining Operations in the Province of Quebec 1911, pp. 103–125

St. Maurice County.

Grondin Mine.

St. Boniface de Shawinigan is on the line of the Canadian Northern railway from Montreal to Quebec. It is 82 miles from Montreal and 92 from Quebec. The ore deposits are on lots 22 and 23 of range VII, Shawinigan township, and a fairly good wagon road about 4 miles long runs from St. Boniface to the place.

The ore consists of a titaniferous magnetite and is associated with gabbro. The largest deposit known is that called the *Grondin mine* on lot 22. The workings consist of a trench, 22 feet long, 10 feet wide and 6 feet deep, all in ore. The magnetic attraction exceeds 60 degrees over an elliptical area 175 feet long and 60 feet wide. The ore averages about 41·5 per cent iron and 5·4 per cent titanium. On the adjoining lot 23, outcrops of a few feet in width have been found.

An unsuccessful attempt to smelt this ore was made about 30 years ago when a small blast furnace was built on lot 17 on the right bank of the Yamachiche river. It was charged with ore from the Grondin mine, but became blocked after 4 days' operation.

Reference:—
Dulieux, Report on Mining Operations in Quebec for 1912, pp. 81–84.

Terrebonne County.

Desgrosbois Deposits.

The outcrops of titaniferous magnetite which are included under this name are on lots 39, 40, and 41 of range VI, Beresford township. The line of the Canadian Pacific railway between Montreal and Mont Laurier runs a few hundred feet from the deposits, with Desgrosbois station two or three lots away. The distance to Ste. Agathe, the nearest village, is 7 miles.

The rock consists of anorthosite, in which titaniferous magnetite occurs in segregated masses. The rock is often impregnated with magnetite and the ore itself frequently encloses feldspar and pyroxene. The probable length of the ore-body on lot 39 is 60 to 70 feet with a maximum width of 27 feet.

On lots 40 and 41 no outcrop could be followed for any great length, 47 by 27 feet being the largest, and this mineralized mass is far from being pure, magnetite being heavily charged with feldspar. The dimensions of other outcrops are from 10 to 15 feet.

An analysis of the ore is as follows:—

Metallic iron	42·85 per cent.
Titanium	6·73 „

The Desgrosbois property is of no economic importance unless larger masses of ore can be discovered, and until better concentrating results can be obtained.

Reference:—
Dulieux, Report on Mining Operations in Province of Quebec for 1912, pp. 72-78.

III.

ILMENITE.

Ilmenites occur at various places throughout Quebec as segregated bodies in anorthosite, but only two localities are known to contain them in quantity. These are in the parish of St. Urbain, Charlevoix county, 9 miles from Baie St. Paul, and at Ivry near Lake Manitou in Beresford township, Terrebonne county.

Charlevoix County.

St. Urbain.

The St. Urbain deposits are among those which have been known for the longest time in Quebec. They lie on the margin of an undulating plateau which borders on the valley of the Riviere du Gouffre in the parish of St. Urbain, Charlevoix county.

In 1872, a corporation called the Canadian Titanic Iron Company built a blast furnace on the St. Urbain plateau, and carried on mining operations on a small scale until 1874, when it failed.

The workings made by this corporation consisted of two open-cuts on lots 351 and 362. The first cut was about 70 feet wide, and was made in a mass of ilmenite. The second open-cut, some 40 or 50 yards southwest of the first one, is nearly filled by slides from the overlying surface clays and gravels, but one of them, with a length of about 30 or 40 feet, appears to be cut entirely in compact ilmenite.

About three-quarters of a mile southwest from these old workings are two properties known locally as "Coulomb's mine" and "The General Electric's mine."

Coulomb's mine lies at the eastern extremity of lot 319, and has two open cuts about 500 feet one from the other, known as the "Eastern" and the "Western" workings. The Western workings comprise a large mass of compact ilmenite from which the overlying clay has been stripped; the exposed rock showed no barren material. From this opening the ore was quarried. The Eastern workings consist of an open-cut about 160 feet in length and 30 feet in width at the bottom. The beginning of the cut was made on the edge of a mass of ore which widened as it proceeded to the west. The ore from these workings is hauled to the village of Baie St. Paul, and in July 1911 some 1500 tons had been shipped from Baie St. Paul to the Titanium Alloy Company, of Niagara Falls, N.Y. The ore has the following composition:—

	1.	2.	3.
Iron	40·09%	42·89%	41·21%
Silica	2·64	3·12	2·68
Sulphur	0·041	0·04	0·04
Phosphorus	0·040	0·04	0·041
Titanium	24·62	21·30	23·00

The *General Electric's mine* consists of two open-cuts about 150 feet apart. One of these showed a triangular mass of ilmenite having a width of about 80 feet; the second one showed a similar mass about 50 feet in width. M. Dulieux was informed that bore-holes have shown the presence of ore to a depth of 100 feet.

The general character and composition of the ore is shown by the following analysis:—

Iron	44·52 per cent.
Silica	1·10 „
Sulphur	Traces.
Phosphorus	„
Titanium	24·98 „

From the *Glen prospect* on lot 31 of St. Urbain range a sample was taken by Dulieux, which on analysis gave the following results:—

Iron	43·06 per cent.
Silica	1·68 „

Sulphur.............................. 0·041 per cent.
Phosphorus.......................... Trace.
Titanium............................. 23.00 „

The Baie St. Paul Titanic Iron Ore Mining and Exporting Company (J. O. Paré, Manager, Baie St. Paul) is the owner of other deposits of ilmenite in the same vicinity, from which shipments amounting to 5,000 tons have been made.

References:—
Dulieux, Mining Operations in the Province of Quebec, 1911 and 1912.
Dulieux, Journal of the Canadian Mining Institute, 1913, p. 361.
J. O. Paré, Baie St. Paul, Charlevoix co., Que., 1914.

Terrebonne County.

Ivry Deposits.

The Ivry deposits are situated on lots 37 and 38, range V, Beresford township, about 3 miles from Ivry station on the Canadian Pacific railway. They are controlled by the Manitou Iron Mining Company of Montreal, J. E. Globensky, Secretary.

Extensive prospecting work has been done and the ore (ilmenite) was to be seen in almost all the different excavations or trenches, along a zone measuring over 700 feet in length and 120 feet in width. Near the foot of the hill a trench is cut across the zone, and shows compact ore for a distance of about 100 feet. At one end of this trench a pit has been sunk to a depth of about 7 feet, the bottom of which is pure ilmenite. The analyses of ores from this locality show from 47 to 48 per cent of metallic iron and 18 to 22 per cent of metallic titanium.

Ore to the amount of 3000 tons has been shipped to the Titanium Alloy Company, Niagara Falls, N.Y. The price paid was $4 per ton f.o.b. Ivry station. Owing to the short distance from the railway, the height of the hill and the size of the ore-bodies, these deposits are more favourably located than those of Baie St. Paul.

References:—
Dulieux, Journal of the Canadian Mining Institute, 1913, pp. 361–366.
J. E. Globensky, 364 University Street, Montreal, Que. 1914.

Wolfe County.

Lake Nicolet.

An occurrence of ilmenite is found on lot 20, concession XI, near the northwestern shore of Lake Nicolet, Ham township.

The deposit occurs in serpentine. Two small outcrops are visible, on the largest of which a pit has been sunk and some ore was raised.

The analysis of the ore is as follows:—

Iron................................46·5 per cent.
Titanium............................15·9 „
Chromium............................ 1·16 „

There is no magnetic attraction except in the immediate vicinity of the outcrop, and even there it is very feeble.

Reference:—

B. F. Haanel, Summary Report for Mines Branch for 1909, p. 109.

IV.

MAGNETIC IRON SANDS.

Saguenay County.

On the north shore of the St. Lawrence river magnetic iron sands are found at various points, the chief deposits of which are located at Bersimis, Moisie, Mingan and Natashkwan, which are 200, 330, 430, and 530 miles, respectively, below Quebec city.

Bersimis and Mingan.

At these points the amount of magnetic sands would not yield more than 5,000 tons of pure magnetite. The magnetite-bearing sands are extremely poor, narrow in width and depth, and not of any considerable extent.

Moisie.

At Moisie, judging from an examination made in 1904 in the interest of European capital, the total quantity of pure magnetite that could be separated from the beach sands is estimated at *20,000 tons*. Of this quantity about 10,000 tons exist on the east side of Moisie river where the sand is richer than that occuring on the west side. Apart from the beaches proper, considerable areas of grassy dunes occur, having an average of not more than 5 per cent of magnetite. Beyond the dunes the magnetite-bearing sands are still encountered but are poorer. Five-eighths of a mile of this district was sampled at intervals along a line projecting inland at approximately right angles to the beach. The samples gave an average result of 0·9 per cent of magnetite.

Natashkwan.

The main deposit of iron sand is found in a bank along the shore of the Gulf running in a nearly easterly direction, commencing at the mouth of the Natashkwan river, continuing to English point (Mt. Joli), a distance of 3 miles. The magnetic sand is chiefly found in an area of grassy dunes, the width of which averages about 500 feet. The amount of sand in the dunes between Natashkwan river and Mt. Joli is estimated by G. C. Mackenzie at 5,800,000 gross tons containing *500,000 tons* of magnetic concentrates of 67 per cent iron. The average iron content of the sand is reported to be 8 to 9 per cent, and the average depth of the sand 15 feet.

Reference:—

G. C. Mackenzie, No. 145, Mines Branch. The Magnetic Iron Sands of Natashkwan.

V.

BOG ORES.

As sources of iron, deposits of this class of ore in Quebec province are now of little but historic interest. From the early days of the colony up till a few years ago, they supplied a number of small charcoal furnaces, but the known deposits, though numerous, are many of them worked out, while those remaining are not of sufficient size to support a modern iron industry.

Among the better known were those of Vaudreuil, of Acton in Bagot county, of St. Wenceslas in Nicolet county, and of Wickham in Drummond county, which supplied the Drummondville furnace, and, best known of all, that at Lac à la Tortue, on the railway from Three Rivers to Grand Mère, which for many years supplied the furnace at Radnor.

References:—

P. E. Dulieux, Les Minèrais de Fer de la Province de Québec, p. 50, Quebec Bureau of Mines, 1915.

R. W. Ells, Report on the Mineral Resources of the Province of Quebec, pp. 21–28 K, Geological Survey of Canada, Annual Report, Vol. IV, 1888–89.

VI.

IRON DEPOSITS OF UNGAVA.

Long Island.

Long island is located in Hudson bay about 12 miles north of Cape Jones at the entrance of James bay. Occurrences of low grade siliceous hematite and iron carbonate similar to the Nastapoka island ores are reported here.

Reference:—

A. P. Low, Geological Survey of Canada, 1900.

Belcher Islands.

The North Belcher islands lie about 120 miles north of Cape Jones, and about 90 miles west of the Ungava coast line. Mr. R. J. Flaherty reports finding hematite on one of these islands in 1914. Some of the samples show iron formation or low grade ore, while one or two are hematite of excellent quality.

Richmond Gulf.

Low grade iron ore deposits are reported to occur on the islands and on the southern shores of Richmond gulf, an indentation of the Ungava coast almost due east of the North Belcher islands.

Reference:—

A. P. Low, Geological Survey of Canada, 1900.

Nastapoka Islands.

The Nastapoka islands, lying along the Ungava coast north of Richmond gulf, are formed from unaltered sedimentary rocks consisting of dolomites, sandstones, shales, jaspilytes, cherts, and ferruginous shales. Associated with these rocks are sheets of dark green trap, which have been injected between the bedding of the stratified rocks.

The following is a general section of the rocks forming the islands:—

Descending order.	Feet.
1. Rusty weathering, dark-grey siliceous rock containing ankerite (carbonate of iron and magnesia) and magnetite	20–100
2. Dark-grey siliceous rock containing magnetite with small quantities of ankerite	50–250
3. Red jaspilyte rich in hematite ore	10–100
4. Red jaspilyte poor in hematite ore	5–20
5. Purple, or greenish-weathering, dark-green, greywacke shales	10–70
6. Red jaspilyte poor in hematite	0–5
7. Light greenish-grey sandstone and shale	10–300
8. Fine-grained dolomite	0–50

In division 1 the typical rock is a dark-grey chert, which contains minute crystals of magnetite scattered through the mass, and also patches of ankerite.

The typical rock of division 2 is a dark-grey fine-grained chert containing considerable magnetite scattered through it in minute crystals; it also contains small quantities of carbonates of iron, magnesia and lime. The beds are usually thin (from 1 to 12 inches), and the partings between them are filled with ore consisting of an intimate mixture of silica and magnetite. These partings vary in thickness, but are generally thin between the upper beds of the division, and 6 to 48 inches towards the bottom. The proportion of magnetite and silica in the ore is, however, not constant, the material varying from a lean ferruginous chert to a magnetite containing upwards of 60 per cent of iron.

The typical rock of division 3 is fine-grained and very siliceous, with minute particles of silica coated with red oxide of iron, forming a coarse impure red jasper. These jasper rocks usually occur in thin broken bands with the partings between them fixed with a finely divided mixture of hematite, magnetite, and jasper.

This division reaches its maximum development on *Gillies and Taylor islands*, where the ores are most concentrated; farther northward the beds become thinner and poorer in ore.

Analyses of a large number of surface samples of the hematite-magnetite ores show an iron content, for the better grades, of 30 to 40 per cent, with silica in equal or larger amounts; both phosphorus and sulphur are low.

Four analyses of average samples taken from what appeared to be the best bed of the carbonate type yielded:—

Manganese, per cent	3·47	3·35	3·97	3·41
Iron „	33·35	30·82	33·76	34·07
Silica „	23·05	23·20	22·94	21·98
Phosphorus, „	0·024	0·031	0·091	0·018

References:—

A. P. Low, Geological Survey of Canada, 1900.
G. R. Mickle, Journal of the Canadian Mining Institute, Vol. V, p. 256.

HOPEWELL ISLANDS.

On all the islands of the Hopewell chain, which lie to the north of the Nastapoka islands, low grade iron deposits are reported.

Reference:—

A. P. Low, Geological Survey of Canada, 1900.

PAYNE RIVER.

Occurrences of iron ore are reported near *Kyak bay* north of the outlet of Payne river on the west coast of Ungava bay.

Reference:—

A. P. Low, Geological Survey of Canada, Vol. XI, 1898, p. 20. L.

Koksoak River.

Bedded iron ores are found in several places along the Koksoak river, which empties into Ungava bay. Going up the river they are first met with on the south bank just below the *Shale chute*, or a few miles below Cambrian lake, where a thin section of jaspery magnetite is overlain by 20 feet of cherty limestone containing blocks described as a mixture of ankerite and magnetite.

An analysis of the jaspery magnetite is as follows:—

Metallic iron	31·28 per cent.
Insoluble matter	55·71 „
Titanic acid	None.

The following analysis represents the upper beds of the carbonate ore:—

Metallic iron	33·62 per cent.
Insoluble matter	4·99 „
Titanic acid	None.

For the next 10 miles, to the south of the *Swampybay river*, exposures of iron-bearing rocks are almost continuous, and the amount of ore in sight must be reckoned by hundreds of millions of tons. The ore is not everywhere high grade, and probably a large proportion of it would be unprofitable to work, but there is certainly an almost inexhaustible supply of high grade ore. Two miles below the last-mentioned exposure, the rocks were found to consist of a 25-foot bed of jaspery ore, composed largely of magnetite, with a small admixture of hematite, underlain by 10 feet of siliceous, ferruginous limestone, holding spathic ore in bands and nodular masses up to several hundred pounds in weight. A great part of the magnetite is nearly pure and contains little jasper. The beds are exposed along the right bank of the river for more than a quarter of a mile.

The rocks were again examined 3½ miles farther downstream, where only the cherty carbonates were found; but half a mile below, the river passes close to a high hill on the west side, where 50 feet of red garnetiferous, siliceous, ferruginous shale and jasper are overlain by 200 feet of jaspery ore, composed chiefly of magnetite and coloured by an admixture of hematite. An analysis of the ore in the garnetiferous rocks gave:—

Metallic iron	19·14	per cent.
Insoluble matter	72·86	„
Titanic acid	None.	

And another analysis of the ore from the beds above gave:—

Metallic iron	48·29	per cent.
Insoluble matter	30·62	„
Titanic acid	None.	

On the same side, half a mile below, the section exposed on the hillside shows 400 feet of jaspery magnetite and hematite, overlain by 50 feet of cherty carbonate ore. A specimen of the jaspery ore containing a large percentage of hematite gave:—

Metallic iron	54·35	per cent.
Insoluble matter	16·03	„
Titanic acid	None.	

The bedded iron ores outcrop along the river for about 3 miles farther downstream to near the mouth of the Swampybay river, and then the main stream turns eastward and passes between banks of shale and siliceous limestone, so that the iron-bearing members are not again seen along its banks.

Reference:—
A. P. Low, Geological Survey of Canada, Vol. VIII, 1895, pp. 283–285 L.

On the banks of *Larch river*, a branch of the Koksoak, large blocks of jaspilyte, or a mixture of jasper and iron ore, have been found; in many the jasper is not abundant, and the blocks are almost pure hematite or a mixture of magnetite and hematite very similar in character and composition to the iron formation at Shale chute.

Reference:—
A. P. Low, Geological Survey of Canada, 1896.

Hamilton River.

On the Hamilton river in eastern Ungava, the cherty carbonate rocks are well developed along the shores and in the hills surrounding the lakes from Birch lake to the Menihek lakes on the Ashuanipi branch. The faulting of the rocks has caused these measures to be repeated in four ridges in a distance of about 25 miles across the strike. The most westerly ridge runs along the west side of the Menihek lakes; the next is along the east side of Astray lake; the third forms the ridge between Dyke and Petitsikapau lakes, and the last forms the watershed between Petitsikapau and the headwaters of the George river.

The concentrated magnetite and hematite ores were first met with at the *rapid discharge of Dyke lake*, where two beds each about 5 feet wide were found associated with cherty carbonate and a siliceous trap ash-rock. At the narrows into Lake Petitsikapau, over 25 miles beyond along the same ridge, the ores again come out on the shore for 200 feet, with a width of 20 feet. Analysis of the ores from this place gave:—

Metallic iron	30·48 per cent.
Insoluble matter	51·22 „
Titanic acid	None.

At the head of the middle northern bay of *Astray lake*, there is a low hill where 150 feet of jaspery magnetite and hematite are seen. Some of the ore-beds are 2 feet thick between the jasper partings. Fifty feet of similar ore are exposed on the shore of the northeast bay, about 2 miles from its head.

At the outlet of the *Menihek lakes*, large blocks of jaspery ore are scattered about, and they appear to rest horizontally on beds of trap. Here the magnetite and jasper are arranged in distinct layers, and the jasper is not broken as in all the other exposures where the rocks have been disturbed. This ore on analysis gives:—

Metallic iron	40·72 per cent.
Insoluble matter	29·90 "
Titanic acid	None.

Reference:—

A. P. Low, Geological Survey of Canada, Vol. VIII, 1895, pp. 285–286 L.

NEW BRUNSWICK.

LIST OF OCCURRENCES INVESTIGATED.

NEW BRUNSWICK.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED.

Carleton County.

Woodstock.

Occurrences of hematite near Woodstock have been known for more than 70 years, and were worked intermittently on a small scale from 1848 to 1884.

The principal ore-beds are situated about 6 miles northwest of Woodstock at *Moody hill*, *Iron Ore hill*, *Maple hill*, and at *Jacksontown*, all on the west side of the St. John river. Other outcrops on the east side of the river are at *Pole hill*, near the *forks of Becaguimec* river and near *Glassville.*

The hematite beds are associated with a series of Silurian slates, usually bluish or greyish in colour, and highly calcareous, but when associated with the iron ore, the slates are more or less reddish or greenish.

The width of the ore-beds is reported to range from 1 to 15 feet. None of the deposits have been worked to a greater depth than 20 feet, indicating that the deposits are very shallow. The total amount of ore mined and smelted at intervals between the years 1848 and 1884 is said to have been about 70,000 tons.

The following analyses show the quality of the ore:—

	1.	2.	3.
Iron	34·867%	48·323%	19·00%
Silica	22·021	5·630	34·214
Sulphur	0·319	0·235	0·337
Phosphorus	0·579	0·028	0·841

Owing to their low iron content and limited extent, the deposits are considered to be of little economic interest.

Reference:—
R. W. Ells, Geol. Sur., Can., Report No. 983, p. 84, 1907.

Charlotte County.

Deer Island.

On Deer island a small vein of magnetite, associated with diabase, has been found. The vein is too small be worked.

Grand Manan Island.

Near Spragg's cove veins of siderite are found cutting slates and limestones.

Lepreau.

Considerable prospecting in search of iron ore has been done about 2 miles west of the village of Lepreau. The rock formation consists of hornblende schist cut by masses of diorite. A few narrow veins of magnetite, having a maximum width of from 2 to 3 inches, are seen in several places on the surface traversing the schist, but even by a large amount of exploration nothing of economic value has been found.

St. George.

In the vicinity of St. George small veins of specular hematite have been noted, cutting the granite. They are of no importance.

References:—
L. W. Bailey, Geol. Sur. Can., Annual Report, Vol. IX, 1897, p. 19 M.
R. W. Ells, Geol. Sur. Can., Report No. 983, pp. 84–85, 1907.

Gloucester County.

Austin Brook.

Bathurst mine (Canada Iron Corporation). (See Vol. I.)

Ellis Iron Claim.

This claim is situated about 4 miles west of St. Rosette, which is about 9 miles north of the town of Bathurst. At this point a deposit of iron ore can be traced by outcrops and magnetic readings for a distance of about 900 feet along the flank of a ridge running about east and west. The ore consists of magnetite in a gangue of garnet, with streaks of magnetite alternating with bands of garnet. The following three analyses represent average samples taken across the ore-body at various points:—

	1.	2.	3.
Iron	48·2%	45·2%	48·4%
Insoluble matter	21·0	27·7	28·9
Sulphur	0·819	....	0·231
Phosphorus	0·036	....	0·023

The development work consists of a tunnel and several open-cuts, showing the ore formation to be from 4 to 14 feet in width.

Reference:—
E. Lindeman, Mines Branch Summary Report, 1908, p. 51.

Tracadie.

Bog iron ore is reported by Dr. R. W. Ells at Tracadie.

Reference:—
R. W. Ells, Geol. Sur. Can., Report No. 983, p. 85, 1907.

Northumberland County.

Northwest Miramichi River.

Large areas of land have been taken up on the Northwest Miramichi river, and its tributaries, Little river, Tomogonops river, West brook, Portage river, and also on the headwaters of Gordon brook, a tributary of Nipisiguit river. No discovery of ore of commercial importance has, however, been made so far.

Reference:—
E. Lindeman, Mines Branch Summary Report, 1908, p. 51.

Queens County.

Small veins of magnetite occur in slates on the Clarendon road, 6 miles west of Gaspereaux station on the Canadian Pacific railway. The slate is associated with intrusions of diabase. On *Coal creek* at the head of Grand lake, nodules of hematite occur in the slates. None of the occurrences are important.

Reference:—
L. W. Bailey, Geol. Sur. Can. Annual Report, Vol. X, 1897, p. 19 M.

St. John County.

Occurrences of hematite are found in altered Devonian rocks at *West beach, near the mouth of Black river*, a few miles east of St. John, and *west of Musquash harbour*. They are intimately associated with quartz veins, and are of too limited extent to be of any economic interest.

Reference:—
R. W. Ells, Geol. Sur. Can., Report No. 983, p. 84, 1907.

Sunbury County.

Maugerville.

Limonite is found at Maugerville, a few miles southeast of Fredericton, and was mined years ago and sent to the Woodstock furnaces.

The ore consists of a mixture of limonite associated with a loamy or peaty material, and has a depth of from 1 to 3 feet. It is found in the form of cakes or loose flattened aggregations, few of them more than 6 to 12 inches in diameter. Owing to the limited extent of the ore, it is considered to be of little economic interest. A similar deposit is reported *at Burton* on the south side of the St. John river.

References:—
R. Chalmers, Geol. Sur. Can. 1882–84, p. 46 GG.
R. W. Ells, Geol. Sur. Can. Report No. 983, p. 84, 1907.
E. Lindeman, Mines Branch, Ottawa, Canada.

York County.

Iron ore occurs as bog iron on the southwest Miramichi near the *forks of the Clearwater;* and in the settlements of *Queensbury* and *Beaver dam;* and as hematite in beds of small extent in the slates near *Oak mountain* southwest of Benton.

In none of these localities is the quality, so far as can be ascertained, of economic importance.

Reference:—
R. W. Ells, Geol. Sur. Can., Report No. 983, p. 85, 1907.

NOVA SCOTIA.

I

NOVA SCOTIA.

LIST OF OCCURRENCES INVESTIGATED (EXCLUSIVE OF CAPE BRETON ISLAND).

II

CAPE BRETON ISLAND.

LIST OF OCCURRENCES INVESTIGATED.

I

NOVA SCOTIA.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED (EXCLUSIVE OF CAPE BRETON ISLAND).

Colchester County.

In this county the principal occurrences of iron ore are situated in the Brookfield, Clifton and Londonderry areas. Minor and unimportant deposits of limonite, massive red hematite and specular hematite occur in fissures in Devonian quartzite along Steel Run creek, 2 miles northeast of Kempton, at Munroe shaft near Upper Kempton, near Easttown, and at Mount Thom.

BROOKFIELD AREA.

There are three deposits in this area, known as the Chambers mine (largely worked out), the Pearson mine, and a third to the west of the above, which has been but little developed. The ore occurs in Devonian rocks near their contact with the Lower Carboniferous.

The Chambers mine is about 3 miles east of Brookfield station on the Intercolonial railway. The ore is found in a lenticular pocket in a gash in red shales, which surround it on all sides. The longer direction of this pocket is roughly parallel with the Devonian-Carboniferous contact, and at a very oblique angle to the stratification, both in strike and dip. The lode was approximately 300 feet long, 40 to 80 feet wide and 200 feet deep.

The deposit was first opened in 1889 by Mr. R. E. Chambers, near the west side of the property of Leander Nelson, the ore being sold to the predecessors of the Londonderry Iron and Mining Company. Subsequently the property was sold to the New Glasgow Iron, Coal and Railway Company, predecessors of the Nova Scotia Steel and Coal Company.

The total output of the mine is said to have been 44,000 tons, and the deposit is now nearly exhausted. The iron ore is in the form of limonite, sometimes massive, sometimes botryoidal. Much of it as mined was mixed with considerable red clay, and during most of the time this was washed out before shipment.

The following analysis represents a number of fortnightly averages of shipments made to Londonderry:—

Iron .... 41·75%
Silica .... 26·90%

An analysis by the Nova Scotia Steel and Coal Company, representing an average of five cars, gave:—

Iron .... 46·5%
Insoluble .... 18·6%
Moisture .... 12·5%

The Pearson mine lies south of the Chambers, and is separated from it by a hard quartzite of variable thickness. The ore is black limonite and siderite.

From the valley of a brook, southward from the Chambers mine, two tunnels were driven northward across the black ore, opening a width of 16 to 20 feet of this and a small pocket of high-grade "bottle" ore. West of the tunnels the ore broadens rapidly to 44 feet, and was worked by a quarry with a 20-foot face. The ore here strikes N.68° E. (mag.) and, when not vertical, dips south at high angles. It keeps its width for some distance westward without change in strike. To the northeast it turns more easterly, narrows, and follows closely the south wall of the Chambers deposit. Its total length is not known, but it has been traced for nearly 300 feet.

On account of imperfect replacement of the country rock, the quality of the ore is so variable that analyses, except of large lots, are of little value. Below are given the average figures for shipments to Londonderry during the last five months of 1906:—

Iron .... 43·87%
Insoluble .... 16·39%

An analysis of a general sample of 80 tons of the high-grade "bottle" ore mentioned above gave:—

Iron .... 49·40%
Insoluble .... 10·28%
Manganese .... Trace.

Clifton Area.

The Clifton mine, (sometimes called Old Barns mine), is situated 7 miles west of Truro on the Midland branch of the Dominion Atlantic railway.

The ore body occurs in Devonian sandstone near its contact with the lower Carboniferous formation.

Two shafts have been sunk on this deposit, about 65 feet apart, and are now full of water. One is said to be 70 feet deep. The ore is chiefly limonite, often botryoidal, lying in concretionary form in sandstone. With it are red hematite, red ochre, goethite and a little earthy matter. From the ore-body, which is said to be about 6 to 7 feet thick, *407 tons* were shipped to Londonderry about 30 years ago.

In 1903, the Londonderry Iron and Mining Company began to operate the mine on contract, but, after *300 tons* had been shipped, operations were discontinued, owing to the low iron content of the ore. The following analyses represent some of the shipments:—

	1.	2.
Iron	32·24%	32·13%
Silica	45·57%	49·68%
Manganese	0·059%	0·068%
Phosphorus	0·034%	0·023%

Londonderry Area.

This area is situated on the south slope of the Cobequid mountains between Portapique river on the west and Debert river on the east, a distance of about 14 miles. It is crossed by the main line of the Intercolonial railway. From East Mines station on the main line a spur runs to the East Mines, while another branch line connects the iron works near Great Village river with the Intercolonial at Londonderry station, the distance being about 3 miles in each case. From the iron works a narrow gauge track runs west as far as Cumberland brook, the westernmost workings in the district.

Iron ore in the vicinity of Great Village river seems to have been known ever since the granting of the land. The first mining operations started in 1849, when 6 Catalan forges and a puddling furnace were erected on the east bank of Great Village river by the Acadia Iron Company. In 1852 the first charcoal blast furnace for making pig-iron was built and this operated intermittently until 1875. The first steel plant was erected in 1870, but was demolished in 1877, when its site was used for rolling mills.

Previous to 1886 the property, which comprises about 35,000 acres, was owned by the Londonderry Iron Company, but was purchased that year by the Steel Company of Canada, which went into liquidation in 1899. In 1902 the Londonderry Iron and Mining Company took over the property, and from the beginning of 1904 until 1908 mining operations were carried on and the blast furnace was in operation. Since then the property has been lying idle. It is now controlled by the Canada Iron Corporation, which went into liquidation in 1913. The total output of ore from the various mines between Great Village river and Cumberland brook is reported to have been over *2,000,000 tons.*

The iron-bearing minerals of the area occur in the Devonian strata, and occupy irregular fissures in these rocks. The most important are siderite, ankerite, both mixed with calcite in places, limonite in various forms, and specular hematite. Siderite and ankerite are the original varieties, while the various iron oxides have been formed by a superficial leaching and oxidation of the carbonates.

The ores have, with one or two exceptions, not been found below the general drainage level of the country. In all the mines so far developed the percentage of oxide in the ore has decreased with depth, while that of the ankerite and siderite has increased, until the ore was of too low grade to be profitably worked. The limonite occurs in a great variety of forms and colours from brown ochre, locally known as paint ore, to black botryoidal limonite (bottle ore), extremely hard and very pure.

The *paint ore* has been the chief productive ore of the area, and is generally found associated with ankerite or siderite and grades into them. The average analysis of 1906 shipments was:—

Iron	40·7%
Insoluble	20·2%

The "*bottle ore*" is shallow and local, and is characteristic for certain parts of the area. It appears to be quite recent in origin and largely occupies cavities in the paint ore or in the wall rock. No large tonnage of "bottle ore" has been mined. The following analysis represents an average sample of "bottle ore":—

Iron	57·7 per cent.
Silica	2·28 „
Alumina	0·38 „
Lime	0·16 „
Magnesia	0·14 „
Manganese	0·64 „
Sulphur	0·016 „
Phosphorus	0·097 „
Volatile matter	13·36 „

Another fairly superficial and local type of ore in the district is the *specular hematite*. This occurs in the paint ore and the deposits vary in size from thin filaments and stringers up to large pockets of many tons. The old workings at East Mines showed a comparatively large percentage of this ore, while those west of Cumberland brook showed a mixture of ankerite, siderite, and specular hematite, and others showed none. The following analysis represents an average sample of specular hematite:—

Iron	67·40 per cent.
Silica	0·40 „
Phosphorus	0·001 „

The following analyses furnished by the Londonderry Iron and Mining Company show the average composition of the different varieties of ore in the Londonderry area, No. 1 being earthy red hematite from Cumberland brook, No. 2, average brown ore from the same point, No. 3, ankerite from Martin brook, and No. 4, brown ore from the Old Mountain mines:—

	1.	2.	3.	4.
Iron	54·00%	47·00%	11·63%	49·90%
Silica	5·30%	15·60%	0·044%	11·50%
Alumina	7·41%	4·11%	......	1·08%
Lime	0·49%	0·87%	27·48%	0·75%
Magnesia	0·57%	0·12%	12·384%	1·064%
Manganese	0·78%	1·06%	0·413%	3·177%
Sulphur	0·03%	0·03%	......	......
Phosphorus	0·08%	0·057%	......	0·143%
Volatile matter	7·80%	33·37%	......	......

The following are the yearly averages of iron and insoluble in ore used in the Londonderry furnace for the year 1906:—

	Iron.	Insoluble.
General brown ore	40·72%	20·20%
Old Mountain brown ore	43·07%	16·94%
General carbonate ore	14·37%	4·31%
Old Mountain carbonate ore	14·38%	3·83%
East Mines carbonate ore	16·63%	4·21%

The principal mines in the area are the *East, Old Mountain* and *West Mines.* West of the West Mines the *Cumberland brook* deposit extends westward towards Matheson brook, and has been opened by No. 1, No. 2 north and No. 2 south levels. On the west side of *Martin brook* (in the west side workings) a shaft 400 feet deep had iron oxides to the bottom. At *Cook brook* farther east seven levels were run, but only an unimportant tonnage of ore was found. The country between Old Mountain and East Mines has been but slightly explored up to the present.

East Mines.

Beginning at Slack brook on the west a continuous series of surface and underground workings extend east to Gory brook, the total distance through which they are uninterrupted being 2,900 feet. Much of the earlier work was quarrying. The longest of these pits is that at Gory brook, running from the Reid to the McLean workings, 650 feet. Practically continuous with it on the west are two other quarries, giving a total length of 1,100 feet.

The mouth of the old Slack Brook level was on the west side of Slack brook, and was run in a northeast and east direction under the creek towards the west end of the Gory Brook workings, the total distance being about 2,250 feet. The first 1,200 feet were in rock, the rest in ore, though but little stoping was done. North of it is the Patrigan level, a rock adit driven northward about 120 feet and just reaching into ore, which is a mixture of ankerite and brown ore. The relation of the two levels indicates that the ore follows two zones, which are, at this point, about 400 feet apart and converging eastward, coming practically together at Gory brook.

The Gory Brook workings consist of a rock adit which runs northward for 175 feet, then bifurcates, one branch going northwest and west, the other northeast and east, the two being connected by a drift along the ore. Two levels have been worked. The upper is 50 to 100 feet below the surface with a considerable amount of stoping. The lower is a continuation of the Slack Brook level and is connected with the upper level by shafts and raises. The upper yielded a much larger proportion of ore, while the lower showed chiefly ankerite with small pockets of brown ore. The extreme distance of the lower workings from the surface is 175 feet.

The other workings are at Wetherbee brook, east of Gory brook. Here the productive zone comes to the edge of the Devonian, ore outcropping against the Carboniferous grits. Very many surface pits are opened, none, however, so extensive as those at Gory brook. The underground development consists of one long level and several very short ones. The Wetherbee or No. 1 level starts from the end of a tram line well up on the hillside, and extends northeast for 350 feet to the ore zone; thence a spur runs irregularly eastward along the ore, and the main level continues northeast and north into a second ore zone at a distance of 400 to 500 feet from the first, there spreading east and west. Some stoping was done along this level. The ore mined was made up of ankerite, siderite, paint or brown ore, and a small amount of specular ore. The last was erratically distributed in small and local veinlets in the brown ore, and especially in the carbonates, with the result that the iron content of the ore was quite variable.

The veins in the East Mines are much brecciated, and the wall-rock of green slates was found in the ore as angular horses at many points. Farther eastward near Pine and Totten brooks, large bodies of ankerite have been developed by exploration, but the amount of oxide is not known. At Totten brook there are old openings on the side of the upland north of what is locally known as the Peter Totten meadow. A proportionately large amount of specular hematite is reported to have been found in these workings, making the shipments higher in iron than those from the other East Mines.

Old Mountain Workings.

On the west side of the west branch of Great Village river are a number of old surface and shallow underground excavations; and here also much of the recent work has been done.

There are four principal levels. These all extend westward toward Cook brook, and are numbered from south to north, 4, 1, 2 and 3. The width, north and south, occupied by the old workings is slightly over 1,200 feet, and the extreme length from the first workings on the river bank to the end of No. 2 level, is approximately 2,100 feet.

No. 4, the southern level, starts 300 feet west of the river and at an altitude of 425 feet. It was run largely in ore, but little stoping was done. The end of the level is 400 feet west of the mouth, and the direction quite irregular. Two very short levels, No. 5 and 6, have been driven into the hillside below No. 4 level, but evidently with negative results.

North of No. 4 is No. 1, one of the two main workings of the Old Mountain. This starts 800 feet west of the river, at an altitude of 532 feet. The tunnelling on No. 1 level was alternately in rock and ore, the latter occurring in several not well-defined veins and pockets. A very noticeable feature is the large ankerite quarry, showing a length east and west of 200 feet, and a breadth of 125 feet.

Five hundred feet north of No. 4 is No. 2 level, at an altitude of 583 feet. This is the second working of importance, extending to a point 1,050 feet west of its portal. Like No. 1, it is stoped out to the surface in places.

No. 3 is the northernmost level and starts at a distance of 750 feet from the river, and at an elevation of 450 feet. It extends westward about 1,100 feet. Owing to its great sinuosity the tunnel is, however, in reality much longer. Its first course takes it 200 feet north of No. 2 to the Gallagher workings, where considerable stoping was done. Thence the drift works gradually south to a point under No. 2 and on the same ore, where a large amount of iron ore has been encountered.

West Mines.

The most extensive workings are those extending from Cumberland brook to Martin brook, and called as a whole West Mine. The upper or No. 5 level extends from one brook to the other, a length of over 1,400 feet in a straight line, and considerably greater by the tunnel through the sinuosity of the latter. The drift was run in ore and all the good ore was stoped out to the surface. Lower levels were driven and much of the ore available from them was stoped out.

The deposit was tapped by three vertical shafts which have now caved. The Dufferin shaft is located 1,340 feet east of the west end of No. 5 level, and extends 310 feet down to No. 9 level, the bottom of the workings at this point. The McClellan is 820 feet east of the former and is 280 feet deep. The Engine shaft is 225 feet east of the McClellan and is 225 feet deep. There are, in addition, numerous air shafts and a number of winzes.

The decrease in quantity and quality of ore downward was very marked, and workings stopped but little below drainage level. The carbonates extend quite irregularly up into the oxidized zone. No. 7 level is approximately at the level of Cumberland brook, and the lowest ore mined, that on No. 9, is less than 100 feet below this. Near Cumberland brook the levels covered a breadth of 300 feet, but going east either the ore-bearing belt narrows or the same amount of effort was not made to trace it, for the levels lie upon a single narrow fissure.

References:—

J. E. Woodman, Mines Branch, Ottawa, Report No. 20.

E. Gilpin, Jr. The Iron Ores of Nova Scotia. Transactions Canadian Society of Civil Engineers, Vol. V, 1891.

Pictou County.

The mountainous region south of the coal-field in Pictou county is chiefly made up of Ordovician and Silurian strata with a large amount of intrusive rocks of various character. On the southwestern edge of these hills near East river, the Lower Carboniferous limestone comes into contact with the Silurian and Ordovician series. This contact is highly sinuous and above it one of the most interesting series of iron ore deposits in the province has been found. Numerous occurrences of hematite have also been met with in the region to the north, associated with the Ordovician and Silurian rocks of the hills, but as far as known their low iron content renders then of no economic importance at the present time. Their appearance is strikingly like that of the Arisaig deposits in Antigonish county.

The deposits near East river have been known since 1828, when some mining was done by the General Mining Association. The Pictou Coal and Iron Company and its successors, the Nova Scotia Steel and Coal Company, developed them later, and all the known deposits are now regarded as exhausted.

The ore was a black to light-brown limonite with a botryoidal or radiated texture and often passing into goethite. The limonite in all the deposits contained more or less manganese, often very unevenly distributed and varying from a fraction of one per cent up to several per cent within the same deposit. In general, however, the percentage of manganese in the ore is reported to have increased eastward.

The iron content of the ore is reported to have averaged from 40 to 48 per cent. The percentage of silica ranged from 14 to 30 per cent, while the phosphorus content is given as 0·030 to 0·075 per cent. The sulphur content was low, ranging from 0·02 to 0·08 per cent.

The nature of the occurrences suggests that similar small deposits may be still found along the contact of the Carboniferous limestone with the older series, which may be mined on a small scale; but that the district should ever become an iron ore producer of any importance does not seem likely.

Occurrences of hematite are reported near Blanchard brook and westward to Iron Ore village on the Glencoe road. A trench near this village exposes an ore-bed 4 feet thick. A sample of the ore gave 41·5 per cent iron.

Holmes Watson "mine," west of Fall brook and two miles south of Sutherland's mills is an occurrence similar to the Sutherland-Meiklefield (See p. 176) deposit, but of lower grade.

Along the west side of Sutherland river and two miles south of Sutherland's Mills are two outcrops of the same type as the Holmes-Watson occurrence.

Other occurrences of hematite are reported a mile east of the Wentworth deposit and on the Fraser farm on the road from Sunnybrae to Iron Ore village, but none of them are known to have promise of economic importance.

East River Area.

The Black Diamond mine lies near the Cameron, and to the south of it. The deposit is reported to lie in a deep depression with slate walls on both sides. The length of the workings is between 800 and 900 feet, the breadth is 20 feet and the depth is from 30 to 40 feet; the amount of ore extracted was approximately 10,000 tons.

The Black Rock mine is the last mine going eastward toward Sunnybrae. The deposit was worked by an open-cut in its upper part, where the ore is reported to have been of good grade. The lower part was worked by a tunnel, and proved to be of inferior grade.

The Cameron mines are south of the Fraser mine. Mr. R. E. Chambers of the Nova Scotia Steel Company reports that the ore-body occupied a shallow basin in slate, with a hanging wall of limestone. The ore-body was worked about 200 feet on the dip, and yielded *10,000 tons* of ore.

Some of the ore still remaining on the surface is high in manganese, while the main body was not. Three samples were taken. No. 450 is a general sample of limonite on the dump, excluding the high grade, hard black ore and the manganic ore; 451 is hard botryoidal limonite, and 452 selected manganic ore from 200 pounds collected from different parts of the dump.

	No. 450.	No. 451.	No. 452.
Iron	50·79%	56·02%	27·92%
Insoluble	17·10%	9·02%	2·31%
Manganese	0·54%	0·46%	31·80%
Phosphorus	0·074%	0·032%	0·062%
Sulphur	0·028%	0·023%	0·002%
Loss on ignition	8·67%	10·15%	11·02%

The John Samuel Cameron mine is a typical contact deposit of the region. From the surface down to a depth of 300 feet along the incline, the limestone has been replaced by a high grade limonite, averaging slightly over 10 feet in thickness for the whole distance. Below the 300-foot level the ore-body began to decrease in thickness and within 75 feet thinned out completely. The total output was between *40,000 and 50,000 tons.*

The Fraser mine is situated one mile north of Bridgeville on the east side of a road that skirts the highlands for many miles. The Nova Scotia Steel Company is reported to have mined approximately *10,000 tons* from this deposit.

The Grant mines are situated near William Grant's brook, and were the centre of activity in the region during the years of control of the Pictou Coal and Iron Company. These are known as the Scotia Grant, Middle Grant and Big Grant mines. The first lies about 300 yards west of William Grant's brook, the second on the east bank of the brook, while the third is a third of a mile east of the brook.

The Scotia Grant mine produced about 10,000 tons. The Middle Grant mine was worked by two adits, the levels in ore totalling several hundred feet. The thickness was 18 feet at the top but decreased downwards. The Big Grant mine had a thickness of 30 feet of ore in places, and contributed a relatively large output.

The McDonald mine was one of the largest in this area and yielded approximately *40,000 tons.* Its depth down the main slope was nearly 400 feet, and the ore-body had a thickness of 25 feet in places.

The Saddler mine lies half a mile east of the Big Grant mine, beside the Corrimony road northward across the mountains. The total output from this mine is reported to have been 10,000 tons. The deposit was worked by a vertical shaft about 170 feet deep, from which cross-cuts were made into the ore.

East of the Saddler mine there has been much desultory prospecting, especially on the *Dan Robert Fraser* property and on that of *James Fraser* of Culloden, with finds of rich float but no ore-body. Where the Glencoe road starts north across the mountains, on the property of *Big Duncan Cameron*, rich float has also been found, but no ore in place.

Sutherland-Meiklefield Deposit.

In the northern zone of Silurian, and two miles from its northern border, half way between the St. Mary's road up Sutherland river and the Meiklefield road up French river on the east, is a narrow bed of red oolitic hematite. The ore strikes roughly east and west and stands nearly vertical. The width varies from 2 to 5 feet. A general sample across the bed gave 41·6 per cent metallic iron.

South McLellan Mountain.

At the little settlement of South McLellan mountain, and west of the road that runs northward over the mountains to the lowland of the coal-fields, there is a prospect called *Webster mine* on which there are beds of red hematite which have been exposed by three openings. The widths of the beds are 2 and 8 feet respectively. Three samples taken at various points gave 23·8, 26·6, and 28·1 per cent metallic iron.

SUTHERLAND RIVER.

The *Wentworth* 'eighteen foot bed' furnished a sample assaying only 31·41 per cent iron.

References:—
E. Hartley, Geol. Sur. Can. 1867–69.
H. Fletcher, Geol. Sur. Can., Annual Report, Vol. V, Part P.
E. Gilpin, Jr., Trans. Can. Soc. Civil Engineers, Vol. V, 1891, p. 10.
J. E. Woodman, Mines Branch, Summary Report, 1909, p. 64.

Antigonish County.

ARISAIG AREA.

The Arisaig iron field is situated in northern Antigonish county on the shores of the Gulf of St. Lawrence. Beginning at Maligant cove and the Arisaig-Antigonish road, sometimes called the Gulf road, it stretches southwestward toward Merigomish, nearly parallel with the shore for 5½ miles to a point south of Arisaig pier.

The part of the district which has attracted most attention lies up in the hills about 1½ miles from the shore, and embraces a narrow strip of country between the East Branch of Doctor's brook on the east and McPherson's farm on the west—a total distance of about 9,000 feet.

The only serious attempt to work the ore deposits was in 1893, when the Nova Scotia Steel and Coal Company had certain portions of it opened up under contract. The operations were chiefly on the "*Tunnel*" *bed* between Iron and McInnes brooks. Some attempt was also made to open up the same bed in the bank on the west side of McInnes brook. *The Trunk Road mine*, which consists of two small openings on either side of Arisaig brook, was opened by the same company at about the same time.

The ore was trammed by gravity from the hill on which the chief openings were situated to the valley of Doctor's brook southeast of John McDonald's. It was then hauled up the steep valley side to the high ground on the northwest, and trammed thence by gravity to Arisaig pier. Operations ceased in 1895. The total amount of ore mined cannot now be ascertained; in 1894, however, *1,376 tons* were delivered at the Ferrona furnace.

In 1910 extensive prospecting by means of trenches and test pits was carried on in the western part of the field by the Arisaig Iron Company, but no attempt was made to take out any ore.

Three groups of rocks are represented in the immediate vicinity of the iron-bearing zone. The oldest is the Ordovician, a series of dark-coloured slates, sandstones and quartzites containing the principal iron ore beds. The dip of the strata is usually nearly vertical. The general strike ranges from northeast in the eastern part of the field to N. 74° E. in the western part. North of the Ordovician series is a canoe-shaped synclinal basin of Silurian rocks. In this occur the iron ore deposits of Arisaig brook (Trunk road) and Ross brook. The third group is a series of basic eruptives. South of the old workings of the Nova Scotia Steel and Coal Company, east of McInnes brook, they come in as green agglomerates and tuffs, apparently parallel with the stratification and lying immediately north of the belt of red Ordovician slates. At Iron brook they form the south wall of the most southerly of the iron ore beds. Besides these tuffs and agglomerates, areas of massive greenstone, called diorite by the early writers on the geology of the district, are of frequent occurrence, notably about East Branch and eastward. In the western part of the field they are less common, but examples may be seen in McInnes and Gillis brooks. They are of importance because of the practical certainty that they cut off the iron on the strike at the eastern end of the field, and the possibility that, in some places at least, they may interfere with the continuity of the ore-bodies at depth.

What may be called the main ore belt extends from the McPherson property on the west to the east branch of Doctor's brook (hereafter called the East Branch) on the east. In this area three distinct beds of iron ore have been traced over considerable distances by means of pits and trenches. The three beds, going from north to south are called the Tunnel or No. 1 lead, the intermediate or No. 2 lead, and the most southerly, the Coarse or No. 3 lead. Beds Nos. 2 and 3 have been exposed at intervals, (though sometimes very long ones), over the entire length of the main ore belt. The beds all dip at high angles to the north, and are nearly vertical. The enclosing rocks are Ordovician quartzites and slates. In the western part of the field, west of McInnes brook, the general trend of the exposures is N. 74° E.; from McInnes brook eastward this swings around to the northeast.

The Tunnel Lead.

The Tunnel lead has been traced by numerous workings from the McPherson farm on the west to the vicinity of Iron brook on the east for a distance of 6,750 feet, and it probably extends 2,000 feet farther east to East Branch. The principal workings lie to the east of McInnes brook and within 1,000 feet of it. It was from this part of the Tunnel lead that the great bulk of the ore mined and shipped by the Nova Scotia Steel and Coal Company was extracted. The ore in these old workings is said to have been from 3½ to 8 feet thick and to have averaged 48 per cent iron as shipped. The ore-bed here dips at 65°–70° to the north. Elsewhere the ore-bed was generally less than 4 feet wide and of inferior quality.

The ore of the Tunnel lead is specially characteristic. It consists of pebbles or irregular masses of coarsely oolitic red hematite, ranging from the size of a small nut to that of an egg, having a copper-brown surface colour, embedded in a matrix of slate and massive hematite. Locally it is called "kidney" ore. The pebble-like portion of the ore appears to be very pure, while the hematite and slate in the matrix grade imperceptibly into each other. The quality of the ore depends on the proportion of slate in the matrix.

According to Woodman averages of analyses from all sources of the Tunnel lead, (1) between Iron and McInnes brooks, (2) McInnes brook and westward, and (3) a general average, give:—

	1.	2.	3.
Iron	48·17%	46·21%	47·30%
Insoluble	18·23%	15·59%	17·48%
Alumina	....	....	6·80%
Lime	....	....	1·33%
Magnesia	....	....	0·450%
Phosphorus	....	....	1·485%
Sulphur	....	....	0·013%

Intermediate or No. 2 Lead.

South of the Tunnel lead and distant from it, usually less than 100 feet, is the Intermediate, or No. 2 lead. This is a 4-foot bed of siliceous red hematite which possibly is continuous from the McPherson farm on the west to the East Branch on the east, a distance of about 8,000 feet. From pit No. 3 at the western end of the ore belt, the bed follows a general course of N. 74° E. through pits Nos. 4, 10, 12, 13, 15, 17, 18 and 20 to pit No. 21. Over this distance the width of ore seen in the pits will average a little less than 4 feet.

East of pit No. 21 the ore belt appears to have been faulted or to have been sharply bent to the north, since the next exposure of the Intermediate lead, in pit No. 22, lies considerably to the north of the general trend of the western pits. At McInnes brook and eastward the ore is exposed on pits Nos. 24, 26, 30, 32, 36, 41, 43, 44, 45, 48 and 50, and the general direction of the line of pits changes to northeast. For some 800 feet east of Iron brook between pits Nos. 41 and 43, no openings have been made and consequently nothing is known concerning the lead over this distance. In the pits near the East Branch the ore is very siliceous.

The walls wherever exposed show quartzite on the south, and a decomposed slaty rock in immediate contact with the ore on the north. The dip varies from vertical to 77° north.

The ore is a fine-grained, siliceous red hematite, oolitic in places and carrying a few shells. A general average of all available analysis is given by Woodman as follows:—

Iron	43·56 per cent.
Silica	14·75 „
Alumina	7·17 „
Lime	2·10 „
Magnesia	0·440 „
Phosphorus	0·783 „
Sulphur	0·010 „

The Coarse or No. 3 Lead.

The Coarse, or No. 3 lead is the most southerly of the three beds, and is also the poorest. It lies roughly 50 to 75 feet south of No. 2, and has been traced for practically the same distance as the latter. West of McInnes brook the maximum width is 4 feet and between McInnes and Iron brooks the maximum is 8 feet.

The average width of the Coarse lead is given by Woodman as 10 feet. This probably applies to the eastern portion of the seam; west of McInnes brook the average width exposed is, as already mentioned, much less, about 4 feet. The walls in the western part of the field are quartzite, on both sides; at McInnes brook and eastward a greenish-grey tufaceous rock forms the south wall.

The ore is very siliceous and coarse-grained, contains visible quartz particles scattered through it, and, in places, is oolitic. A few shells are sometimes found. The iron content is low, the average of a large number of analyses giving only 35.16 per cent iron.

Miscellaneous pits.

In addition to the pits already mentioned, there are, scattered throughout the main ore-field, a number of other occurrences of iron that it has not been possible to correlate with any of the three beds already described. None of these have proven to be as large or as attractive as the ones exploited.

East of the main iron ore field at East Branch narrow beds of red hematite, generally oolitic, have been uncovered at various points. The percentage of iron in samples from these is usually not over 30 per cent. The chief points at which these prospects are located are on the Duncan McKenzie farm, on the west branch of Goat brook, and on the Ronald McDonald farm.

Brown's Mountain Area.

Near *Brown's Mountain*, P.O. (about 8 miles southwest of the ore field at McInnes and Iron brooks) there are two or more ore-beds varying from 5 to 20 feet in thickness. The ore is evidently very siliceous, averaging probably below 30 per cent iron. A part of the thicker bed is merely a grit impregnated with iron.

SOUTHERN ANTIGONISH AREA.

Occurrences of iron ore have been reported from time to time at various points in the southern part of the county, where narrow veins and stringers of specular hematite are found in the Devonian rocks. Occurrences of this type were examined by Woodman at Lochaber, North Lochaber, Pinkie town, Soldiers Grant copper mine, Ireland, Polson lake, McNaughton brook, Polson brook on South river and Caledonia Mills.

In most of these places hematite of exceedingly good quality (iron 69·2%, phosphorus 0·14%, sulphur trace) can be found, but the deposits are too small in extent to be of economic value.

References:—
H. Fletcher, Geol. Sur. Can., 1886, p. 115 P.
E. Gilpin, Jr., Trans. Can. Soc. Civil Engineers, Vol. V, 1891, p. 9.
M. Y. Williams, Geol. Sur. Can., Memoir 60, pp. 38, 142.

Guysborough County.

Hematite, mainly of the specular variety, occurs usually in small veins and stringers in rocks of Devonian age. No body of commercial ore has so far been found. Devonian deposits of this type have been noted at Erinville; Roman Valley, Atwater; Mink, Dumphy and Bowie brooks tributary to Guysborough river; Guysborough; Moon Point and Bigsby Head.

ERINVILLE AREA.

The Archibald or Burns mine was first worked about 40 years ago by the Crane Iron Company of Philadelphia, and it is stated that *3,000 tons* of hematite were shipped and about *1,000 tons* left on the dumps. The mine was developed by shafts, tunnels and open-cuts. No authentic data regarding the extent of the ore-body are available. In the winter of 1900-01 the Dominion Iron and Steel Company did some prospecting one mile west of the old workings on the farm of W. McKinnon, where a vein of hematite 18 inches thick was found cutting the slates.

The best ore on the dump at the Archibald Mine gave on analysis:—

Iron	67·88	per cent.
Insoluble	1·25	„
Phosphorus	0·018	„
Sulphur	1·148	„

The McKinnon vein yielded:—

Iron	69·52	per cent.
Insoluble	0·94	„
Phosphorus	trace.	
Sulphur	0·043	„

References:—
H. Fletcher, Geol. Sur. Can. 1886, p. 115 P.
E. Gilpin, Jr., Transactions Can. Soc. of Civil Engineers, Vol. V, 1891.
J. E. Woodman, Mines Branch, Summary Report, 1908, p. 43.
E. Lindeman, Mines Branch, Ottawa.
W. F. Jennison, Truro, Nova Scotia, 1911.

ROMAN VALLEY AREA.

The Beaton deposits are situated about 10 miles from Heatherton station on the Intercolonial railway. There are two veins, 10 and 12 feet wide respectively. On the latter a shaft has been sunk to the depth of 56 feet. The former has been stripped along the outcrop for ¾ of a mile.

Four analyses give the following range:—

Iron	58·54%	to	68·28%
Silica	1·36	,,	7·20
Phosphorus	0·016	,,	0·056
Sulphur	Trace.	,,	1·27

Reference:—
M. S. Beaton, New Waterford, N.S.

Hants County.

Throughout the county several occurrences of iron ore, especially limonite, are found near the contact of the Devonian and the Carboniferous rocks. In nearly every case the deposits lie in rocks of Devonian age.

GOSHEN AREA.

The Lantz mine is 4 miles southeast of the village of Cambridge and one mile east of the Goshen road. It shows a few pits full of water with no ore on the surface, hence no first-hand knowledge of the deposit can be gained.

The Goshen mine is one mile southwest of the Lantz mine. A few shafts were sunk and some drifting was done here in 1885. At present nothing is in view except a pit and an old ore-dump, exposing "bottle" limonite which in places is associated with ankerite or siderite. No ore outcrops are visible. The following analysis represents a sample from the ore-dump: iron, 34·4%; manganese, 0·42%.

The Tomlinson mine is one mile northeast of the Lantz mine. The old workings consist of a number of caved shafts and pits, ore from two of which is to be seen on adjacent dumps. The ore is chiefly limonite, accompanied by crystalline quartz and pyrolusite. When worked, it was said to contain 6 to 12 per cent of the latter. The productive bed has been reported to be 6 to 8 feet wide at its best. A sample taken from one of the ore-dumps gave: iron, 37·9%; manganese, 1·35%.

Iron ore has been reported from other localities in this district, but these have never been exploited and nothing definite is known about them.

ROCKY BROOK AREA.

The Selma mine is situated west of the mouth of the Shubenacadie river, at the mouth of Rocky brook, and three miles west of the village of Maitland. The nearest railway station is South Maitland, 7 miles by road to the south, on the Midland division of the Dominion Atlantic railway.

The old workings consist of two pits or shafts. At the western pit, on the property of Charles F. Ells, there is a dump of about 15 tons of a mixture of "bottle" limonite and red brownish hematite. The shaft is 12 feet deep and is full of water. The Sweeney pit, about 200 yards east of the former, shows a small dump of similar ore. This pit was sunk by the New Glasgow Iron, Coal and Railway Company, predecessor of the Nova Scotia Steel and Coal Company, and is reported to have shown clean ore in the bottom to a depth of approximately 8 feet without either of the walls being reached. As no further work was done, it is likely that the ore-body proved to be of small extent.

The ore was part limonite and part hematite, containing more of the latter than of the former. An average analysis of the samples from the Sweeney pit taken at the time the pit was sunk is as follows:—

Iron	44·0 per cent.
Silica	10·0 "
Phosphorus	0·05 "
Sulphur	very low.

Subsequently several shallow openings were made on the Ells farm to the west, but only mixed ore and rock were found.

Reference:—
J. E. Woodman, Mines Branch, Ottawa, Report No. 20, p. 134.

Kings County.

In the Triassic trap lying along the Bay of Fundy shore magnetite and magnetic hematite occur in irregular pockets a foot or so wide and a few yards long. Occurrences have been noted outside of Blomidon near Scott's Bay village, at the Vernon mines northwest of Kentville, northwest of Lakeville, and north of Berwick. These deposits are of no commercial importance.

Reference:—
H. Piers, Economic Minerals of Nova Scotia, Dept. of Public Works, N.S., 1906, p. 33.

Annapolis County.

The main iron deposits are situated in the Nictaux-Torbrook area, with others of minor importance, in the vicinity of Clementsport. In the area of the Triassic trap rocks occurrences have been noted at Margaretville, north of Middleton, southwest of Mount Hanley between Chute and Young coves, and north of Annapolis.

Clementsport Area.

Beds of hematite occur between the villages of Clementsport and Clementsvale, and were worked on a small scale in early years. They lie in a series of Silurian slates and quartzites. The workings are locally known as the Potter, Milner, and Milbury mines.

Whether the Milbury, Milner, and Potter trenches have been opened upon the same iron ore-bed or not is not known at present, as none of the occurrences have been traced beyond the individual openings. At the Milbury and Potter workings, only one bed has been cut, but there may be another bed 30 to 40 feet northwest or southeast of this. No authentic information is available regarding the extent of the various deposits. Should they continue beyond the individual openings, it may be possible to trace them by magnetic observations, as the ore is reported to be feebly magnetic.

The *Potter mine* is the easternmost of the three workings, and is on the property of William Brown, west of the direct road between Clementsport and Clementsvale, and about ½ mile north of the crossing at the latter village. It consists of an excavation 390 feet long, 7 to 10 feet wide and 15 to 20 feet deep. The opening shows clean slate walls, but owing to its caved condition, no inspection of the ore-body can be made at the present time. The general strike of the slate formation is N. 56° E., with a dip of 70–80 degrees towards the southeast. Mr. E. Gilpin in his report on the Iron Ores of Nova Scotia, p. 24, gives the following section of the excavation:—

Ore	3 feet, 0 inches.
Slate	2 „ 6 „
Ore	3 „ 6 „
	9 feet, 0 inches.

The ore is reported by Gilpin and Woodman to be hematite partly altered into magnetite. No authentic analysis of the ore is available.

The *Milner openings* consist of two trenches, 35 feet apart, on the farms of H. Milner and T. Potter. The strike of the trenches is about N. 51° E. The north trench is 450 feet long, and shows walls of slate 3 to 4 feet apart. The south trench has a length of 350 feet. Both have caved and no ore is visible in the workings at the present time. Mr. Gilpin reports the ore to be a hematite, partly metamorphosed into magnetite, and yielding about 33 per cent of metallic iron. The thickness of the ore is reported to have varied from 2 to 4 feet.

The *Milbury opening* is on the property of T. Milbury about 1¼ miles west of the Milner workings. It consists of a trench 300 feet long, striking N. 51° E., and shows walls of slate 3·5 feet apart. The trench being partly filled, no outcrops of ore can be seen, nor is any authentic analysis of the ore available.

References:—
E. Gilpin, Jr., Iron Ores of Nova Scotia, Trans. Can. Soc. Civil Engineers, Vol. V, 1891, p. 23.
J. E. Woodman, Mines Branch, Ottawa, Can., Report No. 20, p. 42.

NICTAUX-TORBROOK AREA.

The Nictaux-Torbrook iron area lies south of the Annapolis river and extends along a highland locally known as the South Mountain. It stretches in a southwest direction from the line between Kings and Annapolis county on the east, to the Cleveland mountains on the west, a distance of about 7 miles with a maximum width of about 2 miles.

The district is traversed by two rivers, the Nictaux and the Torbrook, or Black river, both tributaries of the Annapolis. The Nictaux river divides the area into two parts. That to the west is known as the Nictaux, while that to the east is generally called the Torbrook, with Torbrook or Black river flowing through its centre. The principal workings and mines are situated on a ridge about ¼ mile north of the latter river, where four ore-beds are found interstratified with the sedimentary rocks of the region. A parallel zone of ore lies to the south of the Torbrook river at a distance of about 1 mile from the former beds, and may conveniently be referred to as the South range, while the beds north of Black river are called the North range. The principal mines were at one time connected by a spur line with the Dominion Atlantic railway at Wilmot station, the distance being about 5 miles. The Halifax and Southwestern railway has built a spur line 3½ miles long, which connects No. 1 and No. 2 mines of the Canada Iron Corporation with the main railway at Nictaux. During the years 1912-13, the ore was shipped over this road to Port Wade, a distance of 55 miles, and thence by vessel to its destination.

The existence of iron ore in this locality appears to have been known early in the nineteenth century, and efforts were made to manufacture iron at Nictaux. In the year 1825 the Annapolis Iron Mining Company was incorporated and erected a furnace in the village of Clementsport. Part of the ore there treated came from the Nictaux-Torbrook field near Nictaux river. Later a furnace was built at Nictaux and operations carried on for some time. In 1855 an English company continued operations and is reported to have exported *744 tons* of iron in 1858 and *1,125 tons* in 1859. One shaft was opened close by the furnace and one about 2 miles to the east of it. The main supply of limestone came from St. John to Port George on the Bay of Fundy, 10 or 11 miles from the furnace. The pig-iron had to be hauled to the same place for shipment. Charcoal was used as fuel. This method of operation proved too costly and the works were closed in 1863.

About 1870, Messrs. Stearns and Page, the promoters of the railway from Middleton to Bridgewater, turned their attention to the magnetic ores of *Cleveland mountain* on the west side of Nictaux river. An extensive territory was leased with the intention of reopening the old mines on the completion of the railway. But the railway plans did not materialize, and it was not until many years later that the Nictaux and Atlantic railway was formally opened as the Nova Scotia Central railway, now known as the Halifax and Southwestern.

In 1890, R. G. E. Leckie, then manager of the Londonderry Iron and Mining Co., obtained options on certain areas in the eastern part of the district, and in 1891, operations were started at the Leckie mine. The ore was transported to Londonderry. Mining operations were carried on for several years, but ceased in 1896 owing to the closing down of the iron works at Londonderry. In 1903 work was resumed by the Londonderry Iron and Mining Company, and carried on until the summmer of 1906, when the mine became exhausted.

In 1906 an option on certain Torbrook properties was closed and the Annapolis Iron Company was formed to operate in the district, the new company being controlled by the Londonderry interests. Mining operations were started on the Wheelock property, and the railway was extended to this mine from the Leckie mine, a distance of about 2 miles. During the following year the first steps were taken in developing the Martin property, about $\frac{1}{4}$ mile west of Wheelock mine. In 1908 the Annapolis Iron Company was merged into the Canada Iron Corporation, which operated the Wheelock, or No. 1, and Martin, or No. 2, mines from 1910 to August 1913.

Geology.

The area is largely underlain by stratified rocks of Silurian age. They include sandstones with their altered equivalents, quartzites; grey, green, black, and red shales; and limestone, the latter often ferruginous and showing gradations into hematite and magnetite. The sedimentary rocks are bounded on the north by the Triassic sediments of the Annapolis valley, and on the south by a large granite mass. On the west they are bounded by the same granite mass, which here reaches northward to the Triassic rocks. To the east the sediments stretch without interruption for many miles to the Carboniferous formation of Minas basin.

The southern part of the area is entirely occupied by dark green and black slates and quartzites. To the east, the centre of the field and the area north of it present in addition to these rocks, red shales and quartzites of various colours. In the western part only black and grey slates appear, and none of the red shales and slates come to the surface.

The general strike of the sediments is N. 59° E. On the north range the dip is at high angles towards the southeast, while on the south range the strata dip steeply to the southwest. Between the two ranges the dip varies considerably and the strata are found to lie in several synclines, indicating a complex folding of the region.

Intrusives of granite and its basic marginal equivalents are found in numerous places throughout the district, but their exact areal distribution is not known at the present time. Reference has already been made to the large granite mass on the west, which reaches northward to the

Triassic rocks, and cuts the Inglesville area off from the Nictaux-Torbrook area, of which it is a logical extension.

The intrusion of the igneous rocks has had a considerable metamorphic effect upon the sedimentary strata. This is especially the case west of Nictaux river, where the slates are more altered owing to the presence of the granite. On the south range the strata are also more metamorphosed near their contact with the granite.

The South Range.

Outcrops of iron ore have been found at intervals along the south range from the vicinity of the line between Annapolis and Kings counties to Torbrook river, a distance of about $3\frac{2}{3}$ miles. The general strike of the strata is N. 60° E. with a dip varying from perpendicular to 80 degrees towards the northwest. In the western part of the area, on the *properties of T. B. Messenger*, the ore is a siliceous hematite with a marked oolitic structure. Going westward the hematite grades more and more into magnetite, and west of the *Obadiah Brown farm* the ore is chiefly magnetite. Judging from the magnetometric survey made by H. Fréchette, the magnetic attraction is continuous between the Brown farm and Blacks brook, with the exception of two intervals of 150 and 850 feet respectively, where the ore zone could not be traced magnetically. The distance from the Brown farm to Blacks brook is about 6,000 feet, and it would therefore appear that the total length of the ore zone in this part of the field is about 5,000 feet.

The ore is generally found in several parallel beds interbanded with slates, the width of the various ore-beds ranging from 1 to 5 feet. The following sections by Woodman give a good idea of the interbanding of the ore at various places along the range:—

		ft.	in.
	Ore	2	0
Pit on the property of T. B. Messenger:—	Slate	3	0
	Ore	1	0
	Ore	0	11
Pit on the property of W. Wheelock:—	Slate	1	8
	Ore	4	5

The ore is a dark siliceous magnetite of the following composition:—

Iron	46·2	per cent.
Silica	19·3	"
Alumina	5·2	"
Lime	3·0	"
Magnesia	0·5	"
Phosphorus	1·16	"
Sulphur	0·004	"

Pit No. 11 is on the east side of the *property of S. McConnell.* Fletcher gives the following section of the pit:—

	ft.	in.
Ore	0	8
Slate	2	6
Ore	5	0
Slate	2	6
Ore	1	2
Slate	1	5
Ore	1	10
Slate	3	0
Ore	3	4

Total thickness of section 21 feet, 5 inches.

A selected sample taken by Woodman from the 5-ft. bed gave 36·4 per cent iron.

West of Torbrook river several openings have been made on the farms of *M. E. Armstrong, M. F. Hoffman, and G. Vidito.* Some of these pits expose a siliceous magnetite interbanded with slate. Samples of the ore selected by Woodman range from 19 to 24 per cent iron.

On the property of John Heatley, west of Nictaux river, are several openings (Cleveland pits), for the most part old and caved. Some of these pits are the result of the early exploration work in the district, while others were sunk by the Londonderry Iron and Mining Co. The ore consists of a siliceous magnetite interbanded with slate. According to analyses by Woodman, the iron content of the ore ranges from 29 to 42 per cent.

North Range.

On the north range, north of Black river are four distinct beds on two of which numerous pits and openings have been made. The most southern part of these beds is locally known as the Shell bed.

About 65 feet to the northwest of the Shell bed is No. 2 bed which, however, is of no importance. No. 3 bed lies about 100 feet northwest of No. 1, and is generally known as the Hematite bed and sometimes as the Leckie bed. Varying in distance from about 350 to 750 feet to the north-west of No. 1 bed is No. 4 bed, concerning the extent and character of which but very little is at present known.

The Shell bed.

The ore of this bed consists of a fossiliferous hematite, which, in many cases, has been more or less altered to magnetite, and which holds numerous fossils of Lower Devonian age. Its average width is about 5 feet. The following is an average of numerous analyses of the ore compiled by Woodman from various sources:—

Iron	44·132	per cent.
Silica	16·605	"
Alumina	4·843	"
Lime	6·790	"
Phosphorus	0·750	"
Sulphur	0·098	"

An attempt was made to reach the Shell bed by means of a cross-cut from No. 3 level in the Leckie mine, but without success. At the place where it should have been found, the rocks showed approach to the axis of a pitching syncline, and the bed had apparently, if present, turned across the axis above the level of the cross-cut.

The most easterly point at which the Shell bed has been opened is on the Stanley Brown farm, where it showed the following section:—

	ft.	in.
South side, ore	2	4
Slate	2	2
North side, ore	1	9
Total	6	3

An analysis of the ore here gave:—

Iron	49·650	per cent.
Silica	13·360	"
Insoluble	21·460	"
Phosphorus	1·110	"
Sulphur	0·034	"

On the George Holland farm, to the west, the ore is in part oolitic hematite and non-magnetic, a characteristic that does not appear to the westward, where the bed consists chiefly of magnetite.

On the adjacent *farm of M. Hoffman*, two pits on the west side of the property showed respectively 3 feet 6 inches and 2 feet 2 inches of good ore. On the east side a shaft was sunk on the bed to a depth of 156 feet. The dip is 79°, and extremely regular throughout. The ore-bed in the shaft averaged 6 feet in thickness, and an average of 12 analyses was as follows:—

Iron	39·29	per cent.
Silica	20·10	"
Phosphorus	1·04	"

A drill hole on this same farm is said to have cut 6 feet and 3 inches of ore.

On the next farm, belonging to *Page and Stearns*, the Shell bed is represented by 4 feet 10 inches of fossiliferous magnetite, the analysis of which, No. 1, is given below. A shallow drill hole also showed 5 feet of good and 2 feet of inferior ore. No. 2 is an average analysis of the ore:—

	1.	2.
Iron	48·00%	42·10%
Silica	15·10%	15·10%
Alumina	5·10%	......
Lime	2·97%	8·97%
Phosphorus	1·30%	1·25%

A pit on the *Joseph Wheelock farm* showed 4 feet of ore dipping 85° S. E. and striking N. 78° E.

On the Fletcher Wheelock farm, a little farther west is located the Wheelock or No. 1 mine of the Canada Iron Corporation, where the ore-bed has a thickness in places of 18 feet.

Wheelock or No. 1 mine, Canada Iron Corporation. (See Vol. I.)

On the *E. Banks estate*, west of the Wheelock mine, is an open-cut on the Shell bed about 175 feet long. A pit at the west end of the cut showed 7 feet of ore and 10 inches mixed ore and slate on the hanging wall. A sample across the ore taken by Woodman gave the following analysis:—

Iron	49·800	per cent.
Silica	11·320	"
Alumina	7·000	"
Lime	3·800	"
Magnesia	0·550	"
Phosphorus	1·320	"
Sulphur	0·002	"

From here the bed has been traced southwestward by pits and bore-holes to the east side of the *Edward Martin farm*, where a fault throws it about 550 feet to the northwest. As exposed in the pits along this stretch, the ore is a shell magnetite, with reddish-brown streak. Its width is from 5 to 6 feet.

On the J. Allen farm, west of the fault mentioned above, the shell bed has been exposed in a trench for a distance of about 500 feet, and is here 4 feet wide.

On the William Ward property, west of the Bloomington road, openings have been made on what has been regarded as the "Shell" bed. The ore is shell magnetite with a black to brownish streak, not red like the Wheelock mine ore. A sample from an ore-pile lying near an old pit gave:—

Iron	51·49	per cent.
Insoluble	15·37	"

The Hematite, Leckie, or No. 3 Bed.

The Hematite bed consists chiefly of hematite and is generally devoid of fossils. It averages 4 feet 6 inches in thickness, but attains a maximum of 6 feet 6 inches in places.

The most easterly point at which this ore-bed was recognized was at the abandoned Leckie mine.

The *Leckie mine*, which was until 1906 the main stay of the Torbrook field, was opened in 1891 upon the land of C. A. Banks, Samuel Barteaux, Barrs and Burns, close to the Torbrook-Wilmot road. The original extent of land owned by the operators was small, and the ore was mined upon a royalty basis.

In the spring of 1891 two shafts, Nos. 2 (Woodbury) and 4 (Main or Barteaux) were opened, the shallow ore being worked by overhead stoping in one case, and underhand in the other. In the autumn, shafts Nos. 3 (no relics of which now remain) and 5 (Seary) were sunk. Four levels were driven from these shafts, but they are now inaccessible. A spur was built connecting the mine with the main line of the Dominion Atlantic railway at Wilmot station.

The iron ore in the mine is a compact red hematite, for the most part massive and without fossils. In a few instances shells were seen. The rock of the walls is a light-green slate.

A general average analysis of the ore is given below:—

Iron	49·200	per cent.
Silica	15·090	"
Insoluble	15·600	"
Alumina	4·424	"
Lime	4·940	"
Magnesia	0·666	"
Manganese	0·470	"
Phosphorus	0·922	"
Sulphur	0·077	"

The output during 1891, the first year of production, was approximately *10,000 tons*. Early in 1892 a more complete equipment was installed, and by the autumn of that year the capacity of the plant had been increased to 130 tons per day. The total output until the closing of the mine in 1896 was *137,269 tons*. The mine was re-opened in 1903, after which date the Woodbury shaft was used for all hoisting, and the eastern ones abandoned. In 1906 the last of the ore was extracted and the mine was abandoned. The total output from 1903 to 1906 was *56,538 tons*, the ore having an average composition of 44 per cent iron and 16 per cent silica. The ore had a width of about 6·5 feet at the surface, but narrowed to 4 or 5 feet at depth. The ore pinched out downward and westward, which may be due to the proximity of a boss of intrusive rock to the north-west.

The ore-body may be described broadly as a bed, triangular in longitudinal outline. Its general strike is N. 65° E. Its dip in the upper portion is 79° to the southeast. The exact boundaries of some of the workings are not obtainable with certainty, owing to the lack of any completed stope section showing the operations of the old company, and the absence of any final map and stope section, completed to the date of closing of the mine.

On the Stanley Brown farm west of the Leckie mine a section of the bed is as follows:—

South wall, green soft slate.

	ft.	in.
Ore	1	0
Slate	1	3
Ore	0	6
North wall, green soft slate.		
Total	2	9

The ore is red hematite, siliceous, and very light in weight. A few fossil shells are to be seen. An analysis of this ore gave 30·81 per cent iron.

On the property of *George Holland* the ore is about 2 feet wide, dipping 80° to the southeast. The ore is a red hematite, with a fine oolitic structure, and showing shells here and there. The following analysis represents a sample of ore taken from this property:—

Iron	48·929	per cent.
Silica	16·740	„
Alumina	3·500	„
Lime	2·850	„
Magnesia	0·580	„
Phosphorus	1·270	„
Sulphur	0·008	„

On the east side of the property of *M. Hoffman* is the Hoffman shaft, where the development of a mine was at one time in contemplation. Here the hematite bed was met in a cross-cut, and a short drift run on it. The walls are 4 feet apart and unusually firm and good. Only 2 feet of good ore could be found, the remainder of the belt being poor ore and slate. The same light-green slate occurs in the walls as at the Leckie mine.

The Annapolis Iron Company publishes the following analysis from this locality:—

Iron	50·510 per cent.
Silica	13·540 „
Phosphorus	0·990 „
Sulphur	0·038 „

A drill hole cutting the Hematite bed on this farm showed 5 feet 2 inches of ore of which 2 feet are probably good ore. An average analysis of the core gave 29 per cent iron and 31·00 per cent silica.

The next property is credited variously to *Page and Stearns and to J. M. Taylor.* A section of the Hematite bed on this property is given as 3 feet 6 inches mixed ore and slate. The ore is good but narrow, slate bands being frequent.

From the Wheelock mine a cross-cut was run to the Hematite bed, cutting 2 feet 6 inches of ore. An analysis at the time of the first opening gave 45·47% iron and 19·35% insoluble.

Three pits on the *Groucher farm* showed respectively 6 feet, 6 feet 6 inches; and 3 feet 8 inches of ore.

On the Martin farm, next to the east, the Canada Iron Corporation opened up their Martin, or No. 2 mine in which the Leckie, or No. 3 bed has an average thickness of about 5 feet.

Martin, or No. 2 Mine, Canada Iron Corporation. (See Vol. I.)

The last point westward at which the Hematite bed can be identified with any certainty is on the *J. Allan property.*

In addition to the openings already mentioned, occurrences of iron ore have been reported at a number of isolated localities.

Isolated Occurrences.

In the western end of the district the Foster pits on the farm of J. B. Foster, east of Nictaux falls, were opened on a brownish-black magnetic ore, very different in fracture and appearance from that of either the Hematite or the Shell beds. The ore is very variable, but runs high in manganese in most samples, as shown by the following analyses:—

	1.	2.	3.	4.	5.
Iron	30·32%	18·47%	30·840%	25·46%	6·08%
Silica	......	33·50	26·630	32·12	
Lime	......	3·00	......	......	.
Manganese	......	6·19	......	......	13·44
Phosphorus	......	......	0·543	......	.

In the eastern part of the field, near Torbrook river, on the *Peleg Spinney farm*, some badly decayed, coarsely oolitic hematite is to be found on a dump, mixed with ferruginous rock, near one of the workings. The trench is stated to have cut 18 feet of good ore, and 11 feet of mixed ore and red slate on the north, but this claim could not be verified.

Two pits were at one time opened, one on the eastern side of the *Robert Neily farm*, and the second on the line between *the Neily and Peleg Eaton farms*. It is claimed that a bed of shell hematite 11 feet thick was cut, but there is no evidence of it at present. The ore is soft and of low grade.

On *the E. M. Barteaux place*, near the road, a trench was cut for 2,000 feet parallel with the Wilmot road. The rocks are reported to be red slates; and three beds of low grade iron ore, one 6 feet thick, are claimed to have been cut on the range of the ores at and near the Leckie mine. Three calyx drill holes were also sunk, but they cut no ore.

References:—

L. W. Bailey, Geol. Sur., Can., Annual Report, Vol. IX, Part M.
H. Fletcher, Geol. Sur., Can., Annual Report, Vol. XVI, Part A.
J. E. Woodman, Mines Branch, Ottawa, Canada, No. 20, pp. 48–128.
H. Fréchette, Mines Branch, Ottawa, Canada, No. 110.
Information supplied by Canada Iron Corporation, Ltd., Montreal, Canada.

Digby County.

The iron deposits so far as known all lie in volcanic rocks of the Triassic Period. Occurrences have been noted north of Digby and at Rossway, Waterford, Moorehouse, and Mink cove. They consist of irregular veins and pockets of magnetite and magnetic hematite. None have been discovered more than a foot in breadth, and none have shown a greater length than a few yards.

Reference:—

J. E. Woodman, Mines Branch, Ottawa, Can., Report No. 20, p. 130.

II

CAPE BRETON ISLAND.

DESCRIPTIONS OF OCCURRENCES INVESTIGATED.

Cape Breton County.

Iron ore occurs at several points in this county, but the deposits are as a rule in the form of narrow veins or pockets, but though the ore is high grade, the quantities are in most cases not sufficient to form commercial ore-bodies.

On the southeast flank of the Coxheath hills between Sydney and East bay, several small pockets of hematite occur at the contact of Carboniferous conglomerate with the Pre-Cambrian rocks. Intermittent attempts to explore some of these occurrences have, in the past, been made at Smith's brook and other localities, but evidently with negative results.

At Loran harbour, about 3 miles east of Louisburg, occurrences of hematite have been reported by the late H. Fletcher. *On the farm of L. McLean*, on the south side of the harbour, coarse red Carboniferous conglomerate, mixed with red marl, overlies the older rocks. The matrix of this conglomerate sometimes consists of hematite, which also discolours the underlying felsites. On the opposite shore, on *Tully's farm*, large fragments of specular iron ore, brown and red hematite occur in the fields associated with the conglomerate. A considerable amount of trenching and test-pitting has, however, proved that the ore does not occur in workable quantity on these properties.

Some prospecting for iron ore has, in the past, been done by the Nova Scotia Steel and Coal Company, on the *farms of Archie and John Gillis*, situated about ¼ of a mile north of *Grand Mira, South*. (See map No. 313.) The iron-bearing mineral found here is a red hematite grading in places into magnetite. It occurs in narrow bands interstratified with slates of Cambrian age which have been closely folded. The general strike of the formation is northeast with a steep dip towards the northwest or southeast. The workings consist of a number of shallow shafts and test-pits, showing the widths of the various bands to be from 2 to 12 inches.

The following analysis represents a sample taken from one of the ore-piles:—

Iron	62·08	per cent.
Insoluble	6·60	„
Phosphorus	0·369	„
Sulphur	trace.	

Similar deposits occur on the adjoining *farms of L. Gillis and Charles McKinnon*. They are, however, all of too small extent to be of economic importance.

On the farm of Donald Mackeigan, about 2 miles south of *Marion Bridge P. O.*, some trenching and diamond drilling have been done in search for iron ore, but evidently with negative results. All that can be seen here are a few narrow bands of hematite, interstratified with slates and having widths of 2 to 5 inches.

The lakes of Loch Lomond lie in the southwestern part of Cape Breton county, and extend into Richmond county. They occupy a lowland of Carboniferous rocks which themselves lie between Devonian and Pre-Cambrian rocks to the west and Pre-Cambrian to the east. On the *farm of John McVicar*, about 1·5 miles south of Enon post office, exploration work carried on by the Dominion Iron and Steel Company, has exposed some hematite associated with Carboniferous rocks near their contact with syenite of Pre-Cambrian age. Judging from the material taken from the workings, the ore occupies irregular fissures and cavities in the Carboniferous conglomerate, and seems to be of a very pockety character. Wherever unmixed with rock the ore is a hard compact hematite of good quality, and carries in places a considerable percentage of manganese.

A picked sample from one of the ore-piles gave the following analysis:—

Iron	62·10 per cent.
Insoluble	9·70 „
Phosphorus	0·007 „
Sulphur	0·030 „

On the *farm of D. McIntyre*, about one mile south of the McVicar farm, similar occurrences of hematite have been exposed by a number of test-pits. They occur in Carboniferous conglomerate and sandstone. Where exposed, their width is found to range from 2 to 18 inches.

Near Breac brook, 2½ miles east of the settlement of Big Pond, a small deposit of hematite has been opened up on the contact of Lower Carboniferous conglomerate with Pre-Cambrian schist. The ore is reported to have been 2 feet thick at its best, but is of too small extent to be of economic importance. A sample of the best ore gave the following analysis:—

Iron	55·50 per cent.
Insoluble	16·00 „
Phosphorus	0·005 „
Sulphur	0·060 „

On the opposite side of the brook, on the *property of John McKinnon*, a similar contact deposit has been opened up, the thickest part being 18 inches.

Near Ben Eoin, on the east side of East bay, Cape Breton county, is a small deposit of hematite at the contact of the Carboniferous conglomerate with the Pre-Cambrian series. Two tunnels have been driven from the lake level into the hill, one being reported to have a length of 90 feet. No ore can be seen in place, the deposit having been worked out down to the water level. Farther up the hillside, several shallow pits have been dug in the conglomerate, and a shaft sunk 40 feet without cutting any ore.

Barachois Area.

The Ingraham mine is situated about 2 miles southwest of Barachois, at an elevation of about 300 feet above sea-level. The Intercolonial railway passes within 2,000 feet of the workings.

In 1900, about 500 tons of ore are reported to have been shipped from this property to the Dominion Iron and Steel Company at Sydney. Work was resumed in 1906 by the Nova Scotia Steel and Coal Company, which operated the mine under lease for a short time.

The ore consists of hematite which occurs along the contact of Cambrian slate and limestone, occupying irregular fissures and cavities in these rocks. Small masses of compact rich hematite are often found imbedded in the country rock, but the greater portion of the ore is a mixture of hematite, ochreous material and slate. The average iron content of the ore is therefore rather low, and the shipment made to Sydney, in 1900, is reported to have averaged about 44·4 per cent iron, while 33·2 per cent iron is given as an average for the ore from one of the pits operated by the Nova Scotia Steel and Coal Company.

A sample taken from an ore dump near the main shaft gave the following analysis:—

Iron	48·70	per cent.
Silica	4·62	„
Alumina	1·90	„
Lime	9·25	„
Magnesia	0·68	„
Phosphorus	0·065	„
Sulphur	0·087	„

There are several shafts, excavations and pits on the property, but shafts Nos. 1 and 2 are the only workings which have produced any ore. Shaft No. 1 is vertical, and has a depth of 56 feet. It was started in ore, the ore-body dipping at a high angle towards the west. South of the shaft, the ore-body has been stoped for a distance of 60 feet, when it pinched to about one foot in thickness. The width of the stope ranges from 5 to 8 feet. The bottom of the shaft is in slate.

Shaft No. 2 is 25 feet deep. It is reported to be connected at the bottom by a drift 160 feet long with the four pits immediately to the north. At the time of E. Lindeman's visit, the shaft was filled with water and the four pits had caved.

The other shafts, pits and trenches expose limestone and slate with an insignificant amount of hematite in one or two places.

The McPherson mine is situated about one mile east of Barachois siding, on the Intercolonial railway. The distance by rail from Barachois to Sydney is 21·7 miles.

The workings lie in the Boisdale hills, at an elevation of about 470 feet above sea-level, and immediately north of the road leading from Boisdale to Leitch creek. They consists of three shafts and a number of excavations which expose crystalline limestome and schists of Pre-Cambrian age with intrusions of granite and greenstones. The only place where the ore is exposed is in the open-cut near the road where a few small stringers and pockets of magnetite can be seen in the limestone. The principal mining operations have taken place at shafts No. 1 and No. 2. Shaft No. 1 is sunk on an incline into the hillside, while No. 2 is vertical and has a depth of 20 feet. Both these shafts were filled with water at the time of E. Lindeman's visit. Shaft No. 3 has a depth of 32 feet, and has been sunk on the contact of crystalline limestone and greenstone (diorite). No ore is visible in this shaft. The magnetic attraction is confined to a very small area around shafts Nos. 1 and 2, and gives no encouragement for finding any ore-body of economic importance. (See map No. 311).

A sample taken from a small stock pile near shaft No. 1 gave the following analysis:—

Iron	58·10 per cent.
Lime	0·35 "
Magnesia	6·90 "
Alumina	1·92 "
Silica	6·82 "
Phosphorus	0·004 "
Sulphur	0·50 "

Boisdale Area.

The Curry mine is one mile south of the crossing of the French Vale and Boisdale—East Bay roads. The distance from the property to Boisdale railway station on the Intercolonial railway is about 6 miles.

The ore-body lies in crystalline limestone of Pre-Cambrian age, the general strike of which is N. 70° E., dipping vertically, or at a high angle, towards the south. In several places near the ore-body a pegmatitic granite is seen to intrude into the limestone, while farther to the south, Carboniferous conglomerates overlie the older rocks.

The principal workings consist of an open-pit, 110 by 14 feet, from which several hundred tons of good ore have been taken and piled up nearby. The ore-body is reported to have had a width at the surface of from 5 to 9 feet, but it pinched out at a depth of 12 feet. Later attempts to find the ore at greater depth by diamond drilling have also failed. About 75 feet northeast of the main working a small pit and a trench expose limestone but no ore, and all that can be seen of the ore in place are a few narrow veins of hematite in limestone at the west end of the main pit, ranging in width from 2 to 8 inches.

The ore is a massive hematite of good quality, as shown by the following analysis, representing an average sample of the stock pile:—

Iron	56·79 per cent.
Insoluble	12·75 "
Phosphorus	0·008 "
Sulphur	0·022 "

On the farm of P. Campbell, about 3 miles northeast of the Curry farm, and a few hundred feet east of the French Vale road, some prospecting for iron ore has been done, but no workable ore-body discovered.

References:—

E. Gilpin, Jr., Tran. Can. Soc. Civil Engineers, Vol. V, 1891.
J. E. Woodman, Mines Branch, Ottawa, Report No. 20, p. 217.
E. Lindeman, Mines Branch Summary Report, 1913, p. 31.

Inverness County.

Skye mountain, to the west of the head of St. Patrick channel (an offshoot of Great Bras d'Or lake), forms the east end of the Craignish hills. Occurrences of iron ores have been found in various places on the slopes of this mountain, but exploration work carried on here by various parties has failed to reveal any ore-body of economic importance. *At Iron brook* an irregular filling or impregnation of magnetite and hematite in quartzite has been exploited by three tunnels. The two upper tunnels cut a very small irregular body of ore, but the lower tunnel did not cut any ore.

The ore is, as a rule, of low grade, being associated with a considerable amount of quartzite material, and it also contains a large amount of iron pyrites in places. A general sample of the ore in the tunnel gave the following analysis:—

Iron................................	47·40	per cent.
Silica................................	23·70	„
Phosphorus........................	0·57	„
Sulphur............................	0·12	„

The village of Whycocomagh is situated at the head of St. Patrick's channel, about eight miles by the road from Orangedale station on the Intercolonial railway. About 1·5 miles north of Whycocomagh, occurrences of iron ore have been reported *at Campbell's brook*, but they are of no economic importance, being merely Pre-Cambrian limestone, which here and there has been replaced or impregnated with grains of magnetite or ferruginous silicates, chiefly hornblende.

At Logan glen, five miles east of Whycocomagh, specular hematite occurs, occupying irregular fissures in Lower Carboniferous conglomerate, none of which exceed 4 inches in thickness. The area is of no economic value as an iron ore producer.

Upper Glencoe.

A discovery of magnetite was made in 1912 on the *farms of Hugh and John McEachern*, situated about one mile southwest of Upper Glencoe post-office in the Craignish hills, at an elevation of about 500 feet above sea-level. The mine can be reached by wagon road from River Denys or Orangedale stations on the Intercolonial railway, the distance being 12 and 14 miles respectively.

During the last two years considerable trenching and test-pitting have been done on these properties, and at the time of E. Lindeman's visit in May, 1913, an inclined shaft was being sunk by the Dominion Iron and Steel Company, in order to test one of the ore-bodies. The shaft had a depth of about 60 feet along the incline, and was reported to have started in ore, but passed into granite at a depth of 28 feet.

The area being heavily drift-covered, natural exposures are entirely lacking, and the shaft and a few trenches offer the only opportunity for studying the formation which consists of Pre-Cambrian limestone in contact with granite. The magnetite occurs in several detached masses or lenses along this contact, lying one after the other in a north and southerly direction. Judging from the magnetometric survey the ore-bodies are, however, very small and irregular, and are not considered likely to be of economic importance. (See map No. 312).

The following analysis represents a sample taken from a stock pile near the main shaft:—

Iron	49·40	per cent.
Lime	7·55	„
Magnesia	1·88	„
Alumina	1·66	„
Silica	12·18	„
Phosphorus	1·16	„
Sulphur	0·003	„

The exploration work carried on by the Dominion Iron and Steel Company attracted considerable attention, and various parties took up the surrounding land areas in search for iron ore. So far, however, no discovery has been made on these properties.

References:—

E. Gilpin, Jr., Trans. Can. Soc. Civil Engineers, Vol. V, 1891.
J. E. Woodman, Mines Branch, Ottawa, Report No. 20, p. 209.
E. Lindeman, Mines Branch, Summary Report, 1913, p. 31.
J. F. K. Brown, Sydney, Cape Breton, N.S. 1913.

Richmond County.

On the southeast side of West bay, an area of Pre-Cambrian rocks forms a highland extending in a northeast direction from *Black river to Morrison head*, a distance of about 10 miles. Nearly the whole northwest slope of this range of hills and several square miles of the Carboniferous lowland to the southwest have been taken up by licenses to search for iron ore, or leases. So far, however, no discovery of iron ore of economic importance has been made.

On the south side of Madame island, and south of the *village of Arichat* thin veins of specular hematite of no economic importance are found in the Pre-Cambrian felsites of *Mackerel cove* and *Guet cove.*

Many square miles in the vicinity of the *village of St. Peter*, are, or have been covered with leases or licenses to search for iron ore. Narrow veins of specular hematite have been found in several places, but so far no body of sufficient size to warrant working has been exposed.

Reference:—

J. E. Woodman for Mines Branch, Ottawa.

Robinson Cove.

At the head of Robinson cove, about 3 miles from Soldier cove, a deposit of specular hematite and magnetite has been opened near the contact of Devonian sandstone with Carboniferous limestone. A considerable amount of prospecting work has been done on this property at various times, but the data available are too vague to determine the exact extent of the ore-body. Evidently the result of the exploration work was not encouraging. A sample of the best ore obtainable from one of the ore dumps gave the following analysis:

Iron	48·90	per cent.
Insoluble	7·20	"
Phosphorus	0·09	"
Sulphur	1·85	"

Reference:—
E. Lindeman for Mines Branch, Ottawa

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CANADA
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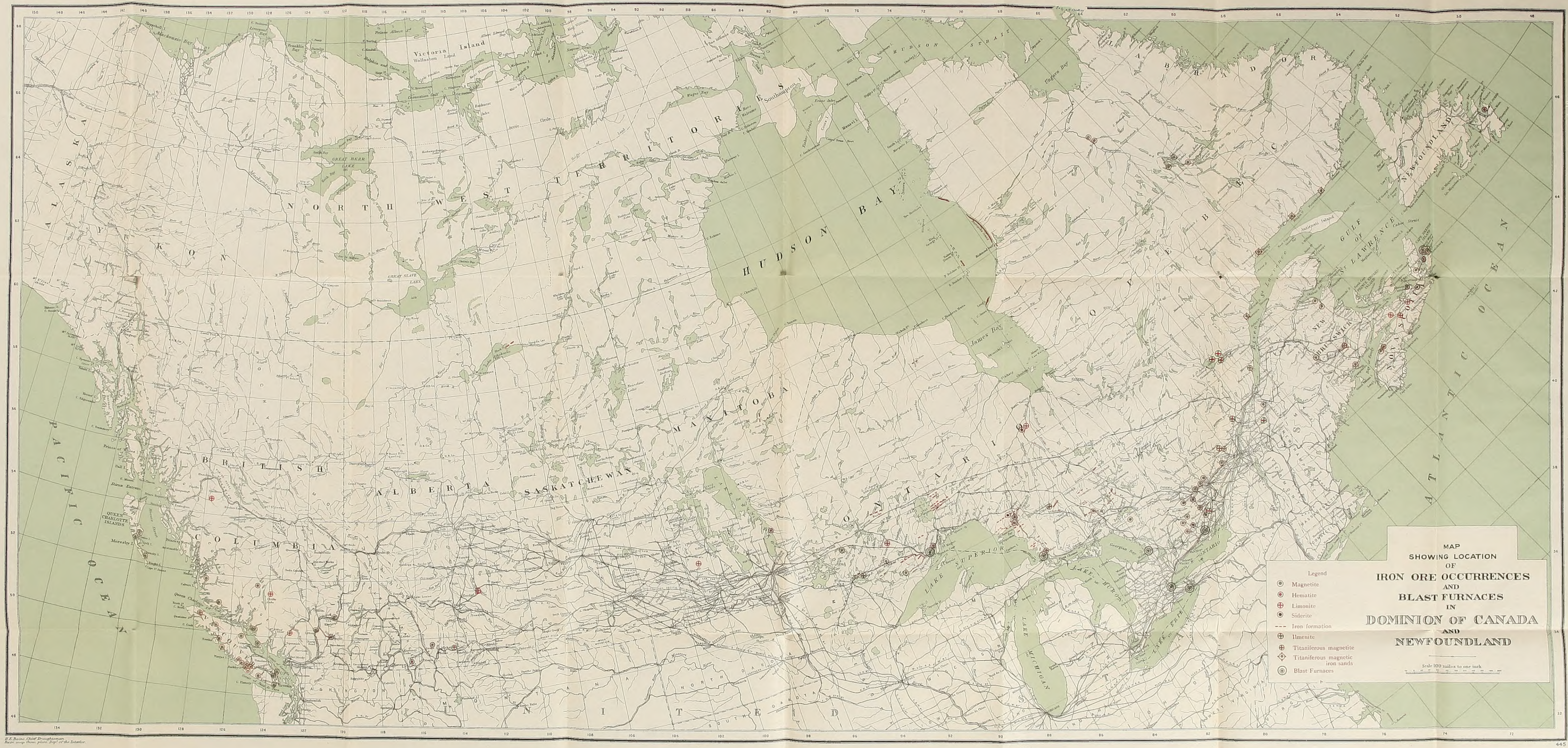

H. E. Baine, Chief Draughtsman
Base map from plate Dep^t of the Interior

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